RAILROAD GAZETTE

ESTABLISHED IN APRIL, 1856.

PUBLISHED EVERY FRIDAY BY THE RAILROAD GAZETTE AT 83 FULTON STREET, NEW YORK
BRANCH OFFICES AT 375 OLD COLONY BUILDING, CHICAGO, AND QUEEN ANNE'S CHAMBERS, WESTMINSTER, LONDON

EDITORIAL ANNOUNCEMENTS.

THE BRITISH AND EASTERN CONTINENTS edition of the Railroad Gazette is published each Friday at Queen Anne's Chambers, Westminster, London. It contains selected reading pages from the Railroad Gazette, together with additional British and foreign matter, and is issued under the name Railway Gazette.

CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

OFFICERS.—In accordance with the law of the state of New York, the following announcement is made of the office of publication, at 83 Fulton St., New York, N.Y., and the names of the officers and editors of The Railroad Gazette:

OFFICERS:

W. H. BOARDMAN, *Prest. and Editor*
E. A. SIMMONS, *Vice-President*
RAY MORRIS, *Secretary*
R. S. CHISOLM, *Treas.*
I. B. RINES, *Cashier*
L. B. SHERMAN, *Western Manager*

EDITORS:

RAY MORRIS, *Managing Editor*
BRAMAN B. ADAMS
CHARLES H. FRY
FRANK W. KRAEGER
GEORGE L. FOWLER
HUGH RANKIN
BRADFORD BOARDMAN

CONTENTS

EDITORIAL:
- Strength and Endurance of Rails 431
- Prompt Payment of Just Claims 431
- Joint Rates between Electric and Steam Railroads 431
- Piece Work on the New Haven 431
- Ballast and Track Surface 432
- The Massachusetts Merger Report 432
- Increased Operating Costs in Belgium 433
- Train Accidents in February 433
- New Publications 434

ILLUSTRATED:
- The Strength and Endurance of Steel Rails. 439
- The Metal Tie 447
- The Ocean Carrier 449
- New Locomotives for the Atchison, Topeka & Santa Fe 453

CONTRIBUTIONS:
- Rail Circuits and Treated Ties 434

MISCELLANEOUS:
- The Engineering and Maintenance of Way Association Convention 435
- Car Surpluses and Shortages March 4 439
- Preliminary Report of the Interstate Commerce Commission on Railroad Earnings 445
- Exhibits at the Maintenance of Way Convention. 445
- A Glimpse of Government Operation (Note) 452

GENERAL NEWS SECTION:
- Notes 455
- Interstate Commerce Commission Rulings 457
- Trade Catalogues 458
- Obituary 459
- Meetings and Announcements 459
- Elections and Appointments 459
- Locomotive Building 460
- Car Building 460
- Railroad Structures 460
- Railroad Construction 461
- Railroad Corporation News 462

VOL. XLIV., No. 13. FRIDAY, MARCH 27, 1908.

We print this week in another column a paper on the strength and endurance of steel rails, by James E. Howard, Inspecting Engineer of the Watertown Arsenal, which is one of the most valuable contributions on rails that has been brought out in recent years. This is the first report of results obtained at the Watertown Arsenal under the increased appropriation. The bulletins which it is proposed to issue from time to time should perform important service in a branch of metallurgy which has been greatly in need of this kind of work.

The Pennsylvania Railroad, with that foresight and intelligent enterprise which characterize its management, has arranged to have freight claims paid more promptly. Not only has the force employed in the claim department been increased, but division freight agents have been empowered to settle small claims which are obviously valid, in cash, instead of waiting to have them audited and paid through the general offices. An attempt has also been made to hasten the settlement of claims in which other carriers are involved by addressing such correspondence more directly to the officers of such companies. This example of the Pennsylvania should be very generally followed. One great cause of dissatisfaction against the railroads has been the result of the methods too often adopted in handling claims. There have been vexatious delays in settlement. Oftentimes, whether because of inefficiency or shorthandedness of the claim department, lack of co-operation between different companies, or—although we believe this to have been rare—actual intent to delay payment, it has seemed as though the railroad company was trying to avoid payment of the claim by discouraging the claimant. Not infrequently the vexation of a small shipper with a delayed claim has been increased and turned into bitterness by knowledge that his large competitor or his competitor with friends among the officers of the road has received prompt payment. It is easy enough to see the disadvantages which have come to railroads as a result of the legislation and agitation of the past two years. The advantages also should be recognized. One exceedingly important advantage, which is typified by this changing attitude of the railroads toward freight claims, is the fact that railroad managers now pretty generally recognize what many of them have in practice long denied—that railroading is a commercial business and that to succeed in it they must have satisfied customers.

The Interstate Commerce Commission in two cases just decided has established a through route and a joint rate between points which formerly lacked such opportunities for through shipment. A summary of these cases will be found in our "Interstate Commerce Commission Rulings" column. The more important of these is the case of the Cedar Falls & Iowa City (Electric) Railway against the Chicago & North-Western. Shippers at points on the electric line had no satisfactory through route from and to Chicago. It appeared that these points were not mere loading points serving one or two shippers, such as those involved in a similar complaint brought earlier by the Chicago & Milwaukee Electric Railway whose contention was denied by the Commission, but small local centers where general merchandising is done and the products of the countryside are concentrated for shipment and, on the other hand, coal, lumber and other commodities are brought in to supply the local needs of the immediately surrounding country. Under these circumstances the Commission ordered through routes and joint rates to be established by the electric line and the steam railroad between interstate points on their respective roads. This decision is likely to have far reaching effect in broadening the usefulness and increasing the importance of interurban electric railways, for it establishes the general principle that for interstate traffic any small community served only by an electric road which carries freight can have the benefit of reasonable joint rates over the electric line and its connecting carriers for through service. If past experience is a criterion, an ultimate result of this decision will be that electric lines will more and more be taken over by their steam railroad connections on exactly the same principle that branch lines of steam railroad have in the past been so extensively acquired.

One of the fundamental questions between employer and employed seems to be coming slowly but steadily to a focus in the case of the New Haven and its shopmen, to the number of some thousands. Forced, like other companies, to sharp economies, that corporation gave notice some weeks ago of a general scheme of piece work in its shops to go into effect March 10. The object was to secure the greatest efficiency in shop labor, to adjust wages to that efficiency and, probably, also to get rid, sooner or later, of a class of shop workers described in the vulgate of shop toil as those who "lie down on their jobs." Representatives of the shopmen's unions met the general manager recently and are understood to have stated curtly and unqualifiedly that they would resist the new order; and, although the order has been suspended until March 28 the company is reported to be equally firm in enforcing it then. The policy of the unions of equalizing wages in the same classes of workmen and sinking the individual in the wage scale seems to be the only ground upon which the New Haven shop unions stand

and no question of breach of contract is raised. It looks therefore now like a head-on collision between the right of the New Haven company as employer to fix the *form* of its labor and the union policy—as the union sees it—of resisting the form. Legally, of course, the union has a right to reject such a form which, in fact, determines the nature of the job. But in that larger domain of bed-rock equities in which both employer and employed must appeal to public sentiment it will be interesting, should both sides remain firm, to see where a mere policy aimed at securing "dead level" wages comes out as against the basic right of the employer to an efficiency scale. But we must not forget that there is an Olympian judgment seat at the federal capital where such a conflict of fundamentals can be assuaged by official search warrant into corporative "misconduct." President Mellen may yet be informed by the voice of authority that he mustn't order piecework so long as the New Haven system includes watered trolleys or holds stock in the Boston & Maine.

BALLAST AND TRACK SURFACE.

In considering the papers on track and ballast, published in the *Railroad Gazette* March 13, it must be kept in mind that it is not possible to make general statements as to the value of particular kinds of ballast, or particular methods of track work, which will be true for all roads, or even for all roads in the same territory. Track that will stand up for two years without resurfacing under slow traffic will not last six months under high speed traffic. The divisions of which Mr. Rettinghouse and Mr. Auerbach are in charge are main line, but the density of traffic is, for example, not comparable with that on road beds within the limits of New York City. At one point on one of these lines, the substructure consists of stone blocks on which is a layer of broken stone, while the ballast proper is large sized, silicious limestone from Clinton Point. The rails are 100-lb. section and shoulder tie plates ⅜ in. and ½ in. thick are used. Yet this track will not maintain line and surface a year. Mr. Rettinghouse recommends stone ballast in sizes from 2 in. down, including a certain proportion of dust. The value of such a mixture depends on the quality of the stone. The dust of certain rocks forms too thick a mud to wash down to subgrade and the result will be a churning track. The depth of ballast to use also depends on local drainage conditions and overhead clearances. He recommends a mixture of three parts sand and five parts coarse pebbles in gravel ballast. Sand washes out easily unless water be prevented from flowing through it. It certainly has a tendency to squeeze out under heavy and fast traffic. The statement that gravel ballast can be maintained more cheaply than stone ballast is generally true. Yet the standard of track to be maintained, the kind of traffic, and the cost of each sort of ballast, must determine this for each place. There are divisions where the use of stone ballast would be as absurd as the use of gravel would be on others. More delicate surface can be obtained on gravel ballast, but it is more difficult to hold it.

Cinder ballast makes excellent track for light traffic until its structure is too far broken down. It has the proper resiliency to make an easy riding track, and it drains freely. It lasts about three years, but then begins to churn. As Mr. Auerbach says, it makes a good basis for gravel ballast; the layer should be about 6 in. thick. It has the advantage of mixing well with other forms of ballast. All ballast will let water through unevenly, which is Mr. Auerbach's criticism of cinder ballast on a new fill. New fills will settle somewhat, but the fill itself and not the ballast is at fault if rain falling on the area of the track alone will cut it away. Ballast is not intended to shed water; its function is to hold up the track and give the water every opportunity of soaking through and getting away somehow and anyhow, so long as it gets away quickly. His suggestion that 10 per cent. of clay be mixed with gravel is hard to understand, except under very light traffic. To be sure, if the surface of such ballast were so water tight as not to let in any water and so keep the bottom of the ties dry, it would be most desirable from the point of view of tie maintenance, but under heavy traffic such ballast would not hold its shape, and the idea is exactly opposed to the required porousness just mentioned.

Mr. Auerbach says that, except on rock ballast, track should never be raised out of face. Although in gravel and sand ballast track can be well surfaced by lifting only at centers and joints, a smoother riding track can be obtained in some ballast by lifting the whole track several inches, and this makes it easier to renew ties. On some divisions, the amount of a section which the gang could raise in a year has been taken as a rough measure of the efficiency of the gang. Part of the section would be raised out of face when repaired, and the rest would be surfaced and lined and tie renewals made not so freely. He says also, that no track becomes so easily center bound as rock. This is a matter of opinion. The statement has been made by one officer that he never had a case of center binding in rock ballast, and only a few in gravel or cinder. His practice is to tamp hard under the rail and for 16 in. each side, and to fill in snugly in the centers of the track, driving stone under at that point with a tamp pick to make sure the ballast is up against the bottom of the tie. As to lining track before raising, this depends on how much lining is necessary. Of course, if the track is a foot out of line, it is a waste of time to raise it first. The lining and surfacing should be carried on as nearly as possible at the same time. Mr. Rettinghouse speaks of the difficulty in getting good section foremen because wages are too low to tempt good men. The remedy is to hunt up promising material and give bonuses, which need not be large enough to make any material difference in maintenance cost. Much can be done for a division by paying 10 or 12 section men $5.00 more a month.

THE MASSACHUSETTS MERGER REPORT.

In these times when the axioms of political economy seem to have turned turtle, and radical speech as well as radical law is turned loose against railroad corporations, it is pleasant to hear one clear call to conservatism and common sense emanating from an official state body. The majority report of the Massachusetts Commission on Commerce and Industry is one of these comforting exceptions to the rule. It is to be sure but a special commission with a single year of legal life which has already expired by statutory limitation. But it has lived long enough to inject a clarifying stream into the turbid whirl of a railroad situation in Massachusetts where politics tipped with demagogism have been confusing alike policies and principles. From a commission that included in its membership such a name as that of Charles Francis Adams was to be expected not only an analysis of the local problem, but an exposition of certain broader principles as applicable to other states as to Massachusetts. The report has, in fact, this double character.

Taking up first certain general principles of the report it is important to notice that it places in the foreground not the penalizing of the New York, New Haven & Hartford Railroad, nor, on the other hand, the promises of that company to make certain specific improvements should the merger with the Boston & Maine be conceded. In place of such penalties and promises the report substitutes the broader and deeper question of the larger public policy for the state, of the merger as an ultimate fact. It is the long look ahead as contrasted with the near and superficial vision filled with the doubts, the passions and the prejudices of the short-sighted onlooker. This calm, dispassionate long distance reasoning is just the sort that our fevered times need. Everywhere, even in mentally well-endowed Massachusetts, is heard the "anti-monopoly" and not much less often the "anti-railroad" cry. A good many of the western and southern railroad commissions, even under the chastening experience of hard times, doubtless charge them up still to the railroads and look on the roads only as objects of punishment. It were well could such bodies, and higher authorities as well, catch the spirit of the Massachusetts commission report.

The commission so far recognizes the existence rather than the value of the anti-monopoly cry in Massachusetts as to combat it by the geographical facts. It shows what the briefest study of the railroad map of New England will show, that the New Haven and the Boston & Maine are connected and not competing systems. Perhaps, in the existing temper of public sentiment in Massachusetts it was not prudent, but the commission might have gone much further and shown certain absolute benefits of monopoly as represented by New England experience. In an editorial article (July 20, 1906, "The Outworkings of Railroad Monopoly") we set forth the facts. In brief, southern New England has had in the New Haven system a complete railroad monopoly made up largely of competing lines consolidated. Northern New England has had in the Boston & Maine a qualified monopoly due also to consolidation of competing lines. And, between, has been the Boston & Albany, not a monopoly. In these three systems the variations downward in freight and passenger rates during the 10 years, 1896-1905, inclusive, were essentially in inverse ratio to the monopoly feature. Allowing for change of rates due to absorption of the New England by the New Haven and of the Fitchburg by the Boston & Maine, the New Haven's average freight rate fell during the ten years a little more than 3.8 per

cent.; on the Boston & Maine a little less than 4.6 per cent.; on the Boston & Albany a little more than 1 per cent. But had the comparison been made for 11 years the New Haven's reduction would have been more than 9 per cent. Or, taking the Fitchburg merger (1900) as the date point, the New Haven freight rate fell during the five years .07 cents, while the Boston & Maine's rose .02 cents and the Boston & Albany's rose .10 cents. In passenger rates during the 10 years the New Haven showed a decrease per passenger mile of a little more than 7.3 per cent.; the Boston & Albany a little less than 6.3 per cent., and the Boston & Maine about 1.7 per cent. But public feeling in Massachusetts is probably more responsive to the "connecting systems" argument than to any returns based on monopoly outworkings in New England. It is to be noted, however, that elsewhere in the report the commission declares that "a monopoly in the case of a public service corporation has no necessary tendency to injure the public. On the contrary it may benefit it and the question in every case is purely one of expediency to be examined on its own merits."

Another point of wide and national interest is the finding of the commission on the question of allowing prosperous public service corporations to issue new stock at par. In Massachusetts prior to 1871 railroad stock could be offered stockholders at par; from 1871 to 1878 it was to be sold at auction; from 1878 to 1893 it could again be offered at par, and since 1893 it and new street railway stock have had to be issued at or above par, but at market price as fixed by the state railroad commission. The fifteen years' test of the law convinces the special commission that the old "par" plan is sane and expedient. The commission's main argument rests upon the theorem that the compulsory market price establishes a new par which the state must adhere to as a basis of regulation. Probably it would be fairer to say that it establishes really two "pars" with very confusing results to the relative rights of old and new stockholders when it comes to a matter of state regulation, especially if based on dividends. The commission also asserts that the "market price" law has deprived the state of the new capital needed for the development of her transportation systems. The subject has been and will always be a complex one with arguments on both sides, and it becomes especially perplexing in a period of rapidly fluctuating and falling values—perplexing not only to the state, but to the corporations. For example, the New Haven company in its last annual report practically announced a new issue of stock at $125 a share, and rights to the stock "to be delivered when as and if issued" were freely sold in the market. A rapidly falling market compelled the company to drop the plan and an issue of 6 per cent. debentures was substituted. From both the public and corporative viewpoint evidently an element of opportunism thus enters the question, resting on stable or fluctuating values. But what cannot be gainsaid as a piece of objective and telling evidence is the unqualified approval of the "par" plan of issue by an intelligent commission in a state whose policy for fifteen years has been in favor of the market value rule.

Turning from the broader meanings of the report to those features which bear specifically upon the merger a long and affirmative argument can be condensed into a few points. The New Haven is a New England corporation in organization, operation and interests. Solidarity with the Boston & Maine spells not only better control of traffic as against outside interests, but better service to the New England public, directly in operation, more remotely in improvements, especially on the Boston & Maine. The actual ownership already by the New Haven of what amounts to a controlling interest in Boston & Maine shares raises obstacles almost or quite insuperable to any plan for diverting such ownership, no matter what the courts decide—and the commission might have added that a final decision of the courts on the serious constitutional questions involved would probably be a matter of years. Almost the same line of reasoning holds good in the matter of the New Haven control of its Massachusetts trolleys. Finally, the financial ability of the New Haven to "handle" the Boston & Maine is certified by the commission's own experts. Their report is based upon the returns for the last fiscal year ended June 30. It might have been better if they had referred to certain changed fiscal conditions since. But if the New Haven has dropped in earning power so has the Boston & Maine, and what may be called the financial ratios of the two companies have remained substantially constant, or, if changed, the variation has been in favor of the New Haven. Incidentally may be noted in the report the first official statement showing the size of the New Haven's trolley system in Massachusetts with its sixteen lines, 565 miles of track, $11,626,200 of capital stock, $6,360,000 of funded debt and $3,234,924 of loans and notes payable. These street railways represent a fifth of the total mileage and about a sixth of the capitalization of the Massachusetts street lines, showing the magnitude of the problem of the proposed severing of the connecting link.

The proposals for safeguarding the merger of the two large railroad systems, which combined, create a unique and firm railroad monopoly in the six New England states, are naturally the real nucleus of this important report. They can be summarized almost in a single sentence. They allow well nigh free control and operation by the New Haven of the Boston & Maine—the localization features not being important—but subject to some pretty radical restrictions based on new and contingent conditions. Those restrictions are twofold: (1) The right of the state, if the merger in a public sense after five years is unsatisfactory, to buy in the New Haven's Boston & Maine shares, and (2) suspensive repeal of the voting power on Boston & Maine shares if control of the New Haven itself passes to an outside interest. On their face these provisions look severe; striking at a principle of ownership and opening a vista of future legislative interference. But five years, barring a "long drag" of hard times, seems long enough for the swift policy of President Mellen to try out the merger, and, under the prospective as well as existing state of public feeling in New England any transfer of the great property seems extremely remote. President Mellen, in his later letter to Governor Guild seems, in fact, to have practically accepted the commission's plan. To the twofold conditions named of Boston & Maine control, should be added a third one suggested by the commission for control by the New Haven of its Massachusetts trolley system by a Massachusetts corporation in which the state shall be represented on the board of directors with provision for sale of control if the plan after ten years works out badly for the public. This applies to the trolleys substantially the same policy as that outlined for the steam railroad merger and with the same arguments in its favor.

The brief report of the minority of two in the commission, one of them a "labor" representative and neither of them entering fully into its deliberations, may be dismissed with short shrift. It is hardly more than a variation of the familiar "anti-monopoly" and "special privilege" pleas coupled with charges against the methods of the commission the high character of whose majority furnishes alone prompt vindication. It is too early to forecast what effect the report will have on the Massachusetts legislature. But at least that body has now before it a working hypothesis for a solution of the merger question and a defined plan supported by constructive criticism where before have been crude utterance and frothy conflict.

The Belgian State Railroads have suffered the common railroad fate in the last year of an increase of expenses out of all proportion to the increase in gross earnings. For the last four years earnings have increased steadily: 7 per cent. from 1904 to 1905; 4½ per cent. from 1905 to 1906, and 2.7 per cent. from 1906 to 1907. But the net earnings remained nearly uniform in the first three years, and last year fell 11 per cent. below those of 1906, in spite of an acquisition of a private railroad which added 3 per cent. to the fixed charges. The surplus over charges has fallen from $2,372,000 in 1904 to $1,856,000 in 1905, and $1,378,000 in 1906; while there is a deficit of $914,500 in 1907. In a country like Belgium, a large part of the production of which competes with other countries for a foreign market, it may be policy for a state railroad system to keep its rates close to cost, to support industry; but a loss which must be made good by taxation can only be regarded as a calamity. The proportion of expenses to gross earnings has grown from 60.03 per cent. in 1904 to 62.60 in 1905, 64.07 in 1906, and 68.61 in 1907. The Parliamentary Committee considering the matter estimates an increase for 1908 of 16 million francs in gross earnings and a further increase of 23 millions in expenses, which would bring up the percentage of expenses to 72.87 per cent.

Train Accidents in February.

Our record of train accidents occurring on the railroads of the United States in February, 1908, includes seven collisions and six derailments. The month of February has broken a long record in that it has furnished no especially prominent accident, using the term "prominent" in the sense with which readers of this column are familiar. It will be recalled, of course, that under the method now used in preparation of this record, accidents which two years ago would have been included in the list are now left out; but even on this basis there have been until now very few if any months in the past ten years in which the most serious accident did not result in five or more fatalities. The causes of this shrinkage are, in a sense, negative, and may be briefly comprised under two heads;

a month in which there was little severe winter weather and that in a restricted territory, and a falling off in traffic. The diminution of traffic means not only fewer trains, but a better average quality of men managing those trains; and the men, whether experienced or inexperienced, working under less severe conditions. The two most serious accidents of the month were each caused by a broken rail. The derailment by this cause of the three rear coaches of Southern Pacific passenger train No. 3 near Forest Grove, Ore., resulted in the death of three passengers and injury to 23 other passengers. As usual, our record is based mainly on accounts published in local daily newspapers.

TRAIN ACCIDENTS IN THE UNITED STATES IN FEBRUARY, 1908.[1]

Collisions.

Date.	Road.	Place.	Kind of Accident.	Kind of Train.	No. persons reported Kil'd.	No. persons reported Inj'd.
3.	Toledo, P. & W.	Bushnell.	xc.	P. & Ft.	0	3
10.	Pennsylvania	Cresson.	xc.	P. & Ft.	1	3
10.	Pennsylvania	Olean.	bc.	Ft. & Ft.	1	0
13.	Balt. & Ohio	Felton.	xc.	P. & Ft.	2	15
16.	Michigan Central	Black Rock.	xc.	P. & Ft.	0	5
*26.	N. Y., N. H. & H.	Bartow.	rc.	Ft. & Ft.	1	1
*27.	Erie.	Brockwayville.	rc.	Ft. & Ft.	2	0

Derailments.

Date.	Road.	Place.	Kind of train.	Cause of derlmt.	No. persons reported Kil'd.	No. persons reported Inj'd.
†3.	Wabash	Britton.	Pass.	b. rail.	2	34
3.	Pennsylvania.	Frackville.	Pass.	b. wheel.	1	0
7.	Pennsylvania	Franklinville.	Pass.	unx.	0	10
7.	Del., Lack. & Westn.	Hoboken.	Pass.	ms.	1	0
†11.	Southern Pacific	*Forest Grove.*	Pass.	b. rail.	3	23
13.	Louis. & Nashville	Cherryville.	Ft.	rock.	1	2

Of the nine serious electric railway accidents reported in the newspapers as happening in the month of February, four resulted in fatal injury to one or more persons; namely, Chicago, Ill.; Hackensack, N. J.; Cambridge, Ohio, and Toledo, Ohio. The Toledo accident caused eight deaths and injury to ten other persons. It was a collision between a passenger train on the Cleveland, Cincinnati, Chicago & St. Louis and an electric car on the Toledo & Western.

NEW PUBLICATIONS.

The Elements of Railroad Engineering. By William G. Raymond, C.E., LL.D., Member American Society of Civil Engineers, Professor of Civil Engineering, and Dean of the College of Applied Science, State University of Iowa. 405 pages; 5½ x 9 in.; 107 figures, 18 plates. Cloth. Price, $3.50. John Wiley & Sons, New York; Chapman & Hall, Ltd., London. 1908.

The book at hand is Volume 2 in a series of three works on railroad engineering in preparation by Dean Raymond. Volume 1, which is to deal with railroad field geometry, and Volume 3, a railroad engineer's field book, have not yet made their appearance, but it should be observed that the three are intended to go together and supplement each other. This fact is important, for it answers what might possibly otherwise be a criticism—that the book on "Elements of Railroad Engineering" covers a tremendous amount of ground and that it is, therefore, impossible for it to handle quite enough of any one topic to entirely complete that topic and put it in shape for use by a practical man. Viewed as one of a series of books, however, and presuming that the other two volumes will complete the stock of detail working knowledge required by the field engineer, the work at hand is admirable.

Perhaps A. M. Wellington did more than any other one man to impress upon the minds of railroad engineers that their work was a means and not an end, and that the successful engineer must keep always in mind the cardinal principle that he was building a railroad to haul freight and passengers and to pay interest on its charges and make some profit for its owners. Dean Raymond does not discuss the economics of railroad location with anything like the detail of Wellington, but he keeps the fundamentals perfectly clear in the mind of his reader. So far as the main scope of the work is concerned, it may be said that the author has brought Wellington up to date better than anybody else has done. He was probably wise in not attempting, himself, to handle, in one volume, all the detail necessary for practical working. A volume big enough to hold this is too big to carry around, and the information contained in it is likewise too big to carry around. The author therefore adopts the expedient of giving principles with quite remarkable clearness, and then of supplying references (not too many of them, either,) to the books that the engineer in the field really ought to read to complete his researches.

The author says in his preface that a railroad with its rolling stock and buildings constitutes a manufacturing plant which its owners operate in the manufacture and sale of transportation. The layout or arrangement of a modern manufacturing plant is as much an item of design as is each individual machine or process; hence the book attempts to describe the fixed portion of a railroad plant and to give the underlying principles of the design of its layout.

After treating of the inception of a railroad enterprise, of the formation of companies, of stocks, bonds (in which the minor error is made of saying that the promises to pay are generally in units of $100 instead of $1,000), of engineers' estimates, construction, failures, overcapitalization, stock watering, valuation, the relation of the railroad to the public and the duty of the engineer, the author proceeds to the more technical parts of the work. There is a chapter on alinement, entirely descriptive and mathematical; a chapter on rails, in which manufacture, chemical composition, form, life of rail and specifications and inspections are touched upon; a chapter on rail fastenings and joints, on ties, ballast and roadbed, on culverts and bridges, turnouts, side tracks and yards, elevation of the outer rail, signaling, the locomotive and its work, locomotive and grade problems, railroad expenditures, effect on operating expenses of changes in the number of trains when tonnage remains constant, etc. Thus it will be seen that the book is really a mixture of descriptive engineering and of operating and engineering economics.

It is very clear that the author's aim throughout has been to give only salient points, and so to express them as to clear up absolutely the real and vital theory of each topic in the engineer's mind. In this he has succeeded extremely well, and we regard the work as being useful and important.

Bond Offerings Indexed, a Directory of Miscellaneous Bonds, showing where they possibly may be bought or sold. By Roger W. Babson, by whom the book is also published, at Wellesley Hills, Mass. 1908 Edition. 284 pages; 4 x 6½ in.; leather. Price, $5.00, with reductions for large orders.

This pocket book in a highly specialized field is of very great utility. It purports to give a complete list of all bonds, except municipal bonds, offered during 1907 in this country, together with the names of the bankers offering them and the high and low prices at which the bonds sold during the year. We know of no other way in which bond offerings can so readily be ascertained and checked as by the use of this book. Mr. Babson is well known for his statistical work in preparing card catalogue descriptions of bonds and in issuing many other records and aids to the bond business, and we have considerable confidence in the accuracy of his results. Entirely apart from the purposes for which the book is issued, it throws an interesting light on the bond issues which are placed before the American investor each year and upon the necessity of dealing with careful and trustworthy banking houses. Without attempting to count the offerings, but estimating the whole by a count of a few pages, it is apparent that there must be over 4,000 offerings listed in this book, which, as stated, excludes municipals.

[1] Abbreviations and marks used in Accident List:

rc.....Real collision.
bc.....Butting collision.
xc.....Other collisions: as at crossings or in yards. Where only one train is mentioned, it is usually a case of a train running into a standing car or cars, or a collision due to a train breaking in two on a descending grade.
b.....Broken.
d.....Defective.
dr.....Defect of roadway.
eq.....Defect in car or engine.
n.....Negligence.
unf.....Unforeseen obstruction.
unx.....Unexplained.
derail.....Open derailing switch (negligence of engineman or signalman).
ms.....Misplaced switch.
acc. obst..Accidental obstruction.
malice....Malicious obstruction of track or misplacement of switch.
boiler.....Explosion of boiler of locomotive on road.
fire.....Cars burned while running.
Pass.....Passenger train.
Ft.....Freight train (includes empty engines, work trains, etc.).
*Wreck wholly or partly destroyed by fire.
†One or more passengers killed.

CONTRIBUTIONS

Rail Circuits and Treated Ties.

Jamaica, N. Y., March 15, 1908.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I have read with much interest your editorial on the above subject in your issue of March 13, 1908. I note that you say that "Signal engineers claim recently to have established the fact that there is a storage battery effect from these ties, but it does not interfere with the working of the circuits under the renewal conditions mentioned." I wish to take exception to this statement. At one time I had charge of a track-circuited section about 3,500 ft. long in which there was a cut section. All the ties were creosoted. The cut section merely broke the circuit for the track in its rear but did not shunt it. During the summer the signal governing the section stood clear after a train passed the cut section. Investigation disclosed the fact that the ties were acting as storage cells. Between trains the tie storage battery was charged by the track battery. When the battery circuit was opened by the cut section relay the ties discharged into the rails and picked up the main track relay clearing the signal. The trouble was remedied by adding a shunt to the cut section. This happened several years ago.

W. H. ARKENBURGH.

The Engineering and Maintenance of Way Association Convention.

The ninth annual convention of the American Railway Engineering and Maintenance of Way Association was held in the Auditorium Hotel, Chicago, March 17, 18 and 19. The meeting was the largest the association has had, 266 members being in attendance. The total membership is now 650; there were 106 new members added during the year, the net gain being 78. The officers for the ensuing year are: President, Walter G. Berg (Lehigh Valley, First Vice-President; W. McNab (Grand Trunk), Second Vice-President; L. C. Fritch (Ill. Cent.); Secretary, E. H. Fritch, re-elected; Treasurer, W. S. Dawley (Mo. & N. Ark.) re-elected. Directors for three years, C. S. Churchill (N. & W.) and E. F. Wendt (P. & L. E.).

President A. W. Johnston (N. Y. C. & St. L.) called the meeting to order at 10.20 a.m., March 17. His address congratulated the association on the record of progress made during the nine years of its existence and the influential position it occupies in the railroad and engineering world. Reference in detail to the work of various committees was prefaced by comment on the condition of public mind which has been created by official reports of railroad accidents. "The make-up of such reports does not enable the ordinary reader to differentiate between those accidents arising from defects in railroad structures or equipment and those occurring from neglect or disobedience of employees, nor is the public rightfully informed as to the casualties to persons not employed in train service, so that the impression has gone forth, in spite of the increasing efforts of the railroads to promote the safety of travel, that the companies are indifferent and indisposed to heed suggestions or commands from authoritative sources. The answer to this may be found in the reports of committees of this association and of allied associations dealing with railroad problems. Among the questions particularly affecting public travel, more prominently discussed in legislative and other official bodies and by the public press and made the subject of serious inquiry, are those dealing with secure permanent way and efficient train protection." The work of the committees on Rail and on Signaling and Interlocking were particularly referred to in this connection, and also because these topics have been the subject of special consideration by the American Railway Association.

Other special topics for association work which were discussed in the address were the impact tests to determine the effects of moving loads on bridges—investigation of the question of flat spots on wheels in co-operation with the Master Car Builders' Association—a special committee having been appointed for this purpose, and the troubles from brine drippings from refrigerator cars, with the resultant bad effect on bridges, rails and particularly on signal circuits. This last evil, caused by brine, has only recently been brought to the attention of the association. Since it may have a serious bearing on the question of safe train operation it is worthy of careful inquiry by a committee.

DISCUSSION OF REPORTS.

Uniform Rules.—The committee submitted as its report a set of rules governing supervisors of signals. These were printed in the *Railroad Gazette* last week in the synopses of reports. The ten rules were adopted without change except a slight modification of wording in No. 9. Some objection was raised to the use of the word "foreman" in Nos. 5 and 6, because men maintaining signals are not always in charge of a gang foreman and may report direct to the supervisor. It was pointed out by the chairman of the committee, however, that these rules followed the form of others already adopted and printed in the Manual of Recommended Practice, and a change of the character desired would have to be made there also. A motion to change the wording was lost.

Two suggestions were made for points to be considered by the committee during the coming year: (1) Regarding the responsibility of the supervisor of signals in connection with the proper maintenance of switch points as affected by the working of signals, and (2) the responsibility of the supervisor with reference to the maintenance of insulated rail joints.

Signaling and Interlocking.—The committee changed the wording of the two conclusions printed in Bulletin 94 to read as follows:

(1) That the Requisite Indications, Exhibit No. 1, are adequate, permit a uniform system of signaling, are not in conflict with existing systems, and are recommended to the American Railway Association for approval.

(2) That the Requisites of Installation as set forth are practicable, form an adequate and proper basis for the design of a system of aspects by which the requisite indications may be displayed, provide an excellent means for attaining a uniform, universal system of signaling, and are, therefore, indorsed by this association and submitted to the American Railway Association for such action as may be necessary to enable roads desiring to use them to do so with the approval of that association.

The chairman also stated that this report was submitted by letter ballot to the Railway Signal Association, and was adopted, and that the requisites of installation were those of the Standard Code, with such changes and additions as the committee deemed essential.

Under the requisites of installation for the telegraph block system, light was asked on the paragraph reading: "A distinctive position of the arm for the caution approach indication."

The chairman explained that it was simply the use of a signal in the 45 deg. position for the distant signal, instead of a fish-tail arm standing at horizontal for caution—the same position of the arm as the stop indication for the home signal. The idea is to make the arm distinctive by position instead of by form.

Information was asked as to why no mention was made of disc signals in the requisites of installation for the automatic block system. It was thought by some that this omission might appear to discredit disc signals as good practice. In explanation it was stated that in order to get a uniform system of signals one form only could be used, and the semaphore, as the form generally used, was the one taken. All of the indications can be given with disc signals. It was pointed out that the Standard Code mentions only semaphores directly in its requisites of installation, discs being mentioned in a foot note and in the rules.

The requisites, "Adequate approach indications for all high-speed signals," which was one of the additions by the committee, occasioned considerable discussion.

Mr. Ewing (P. & R.).—Take a junction on a four-track railroad, where there are several routes, some high speed and one or more low speed, what does the "adequate approach indication for all high-speed signals" mean in a case of that kind?

Mr. Rudd (chairman of committee).—It would mean the distant signal for high-speed signals. Under these requisites of installation the interlocking signal would have a high, a medium and a low speed arm. There would be two "distant" arms for the high and the medium speeds.

Mr. Ewing.—As I understand it this method contemplates one blade for all high speeds. The one distant signal would give one distant indication for that high-speed route. There is no indication to the engineman as to what route he is going to take.

Mr. Rudd.—If there are two diverging routes of equal speed the second arm will govern both. He would get no indication in that case any more than when he comes to a terminal with a number of different ways of going from one signal to another. He gets an indication that he can proceed at a certain rate of speed. That is all he needs.

Following this there was considerable questioning and explanation concerning speed and route signaling, although attention was called to the fact that the 1907 Manual has signal arrangements and indications covering speed signaling, and the subject therefore is not a new one to the association.

W. C. Cushing (Pennsylvania Lines West) moved that in the requisite under interlocking signals reading "short arms and short range lights for all low-speed indications and dwarf signals" the words "short range lights" be stricken out.

Mr. Rudd explained the two-light system for speed signaling and the confusion that might result from having a long-range low-speed light. After some further explanation of the advantages of the short range light by other members the motion was put to a vote and lost.

Exhibit No. 1 referred to in the first conclusion was an outline of indications for a method of uniform signaling. Four indications were given under "stop," the fourth one being "stop within certain limits." This indication has been eliminated by the Railway Signal Association. It was included in this report by a vote of six to five of the committee because it conforms to present practice on a great many roads in respect to train order signals, although it is not sanctioned by the Standard Code. The reason for the practice is that the signal being placed in front of the telegraph office a passenger train, for instance, is allowed to pull by the signal far enough to do its station work conveniently. Discarding this indication necessitates providing a substitute. After considerable discussion it was voted to strike out this indication from the table.

The two conclusions proposed by the committee were then adopted.

Water Service.—The report of this committee consisted merely of a revision of the material in the Manual of Recommended Practice on the subject of quality of water, with methods of treatment and results obtained therefrom. These were adopted by the convention as printed, except for one slight change in wording in paragraph 11.

Buildings.—The conclusions on locomotive coaling stations were considered first. The first four having been adopted last year and reproduced in this report for convenience of discussion No. 5 was taken up first. This was adopted without discussion.

No. 6 covered points where the quantity of coal handled is small, it being recommended that the coaling be done directly from cars, or from cars to an elevated platform provided with a jib crane. Objection was made to specifying an elevated platform, the idea being that this would cost more than one not raised. The chairman pointed out that it saved in lifting the coal by the crane and

saved time. However, by striking out this word it allowed any kind of platform to be used, and the conclusion was finally adopted in that form.

No. 7 read "At terminals where the daily consumption of coal does not exceed 75 tons, a locomotive crane with clam-shell bucket is desirable, provided that there is at such terminal other work that can be economically performed by the locomotive crane."

The question was asked why a limit of 75 tons was established for the locomotive crane, and considerable discussion followed regarding the advisability of setting capacity limitations for different devices and methods. Mr. Coburn, of the committee, said: "We feel that the association has given us a very difficult task. The coaling plant question is something which has not been thoroughly developed. There are a great many different kinds, and very few of the members have had a broad experience. We feel that it is going to be impossible for this association to agree on any satisfactory conclusions in regard to coaling plants. But we endeavored to meet the wishes of the association and prepared recommendations, and, as the minority report shows, we could not agree among ourselves. Referring to this particular point, it seemed to us that the locomotive crane was not a successful appliance where a large number of engines were handled or where they were liable to come in bunched. The experience at terminals has not been satisfactory. Another thing about the locomotive crane is that it provides no storage. If storage be provided, the cost of the plant is so heavy that its total cost, including interest and depreciation, and the cost of storage in cars, makes the cost of a locomotive crane excessive."

The first result of the discussion of this conclusion was to refer it back to the committee for further consideration, but this action was later reconsidered and a substitute conclusion adopted instead. This substitute, offered by Mr. Ewing, was: "At terminals, under certain conditions, a locomotive crane, with suitable bucket, is desirable, particularly where other work can be economically performed by the crane."

No. 8 read: "At terminals where the requirements are from 75 to 200 tons per day and a deep foundation is practicable, a 'balanced two-bucket hoist type' of coaling station is recommended." Mr. Coburn submitted a minority conclusion reading, "At terminals where the requirements do not exceed 200 tons a day, when the desired storage is not so great that auxiliary buckets are necessary and where a deep foundation is practicable, a two-bucket hoist is recommended." His reason was that he did not consider the two-bucket hoist suitable for large storage. It was moved to adopt the minority recommendation, changing "200" to "300," however; in this form the conclusion was adopted.

The last conclusion recommended, for plants larger than previously provided for, the trestle type where conditions permit, and where not permissible, a mechanical conveyor type. The minority recommendation was primarily for the mechanical conveyor plant. Some discussion of the relative economy of the two types ensued and the majority recommendation was adopted.

It was then decided to consolidate conclusions 6, 7, 8 and 9 with No. 5, making them sub-paragraphs marked a, b, c and d.

On the subject of Reinforced Concrete for Roundhouses, four conclusions were submitted. The first, providing that reinforced concrete should be used below the floor where it is cheaper than plain concrete, was adopted without much discussion.

The second, reading "The additional security against interruption to traffic warrants the construction of a roundhouse with a reinforced concrete roof," occasioned considerable discussion. Asked in what way the roof of the roundhouse might insure additional security against interruption to traffic, Mr. Coburn explained that the committee had in mind the question of fire. "Our idea was that the difference between the cost of the two types of houses shown was so slight that the matter should depend entirely upon the results to be gained from the use of each of the types; that while the figures showed that the reinforced concrete house was cheaper, still the advantages was so slight that there must be some other advantage to warrant the additional first cost, and we thought the saving from danger from fire was well worthy of that cost." It was then suggested that the words "from fire" be inserted after "traffic," which was done.

Mr. Schwitzer, of the Canadian Pacific, told of the troubles they had had with the reinforced concrete roofs on the roundhouses of this material on their line. "We put up several of these houses and came to the conclusion that they are a failure for the reason that steam makes such heavy condensation inside. We had to put slabs under the roof to prevent the bad effect of the moisture in extremely cold weather. Because of this, we have practically given up altogether the idea of concrete. We have had six or eight houses with the protecting slabs made of expanded metal and cement plaster. The fumes seemed to get through to the expanded metal and eat it out, and I expect it will be only a short time before the main roof itself is acted on in the same way. We also find it extremely difficult to make the roof water-tight."

It was suggested to omit the conclusion, but after some further discussion it was changed to read, "The additional security against interruption to traffic from fire warrants the serious consideration of the construction of a roundhouse with a reinforced concrete roof," and in this form it was adopted.

No. 3 read, "When the roof is concrete, the columns, except those supporting doors, should be of the same material." This was amended by striking out "except those supporting doors."

No. 4 was adopted as printed.

The committee asked that the topic of "best method for smoke removal, ventilation and heating of a roundhouse" be referred back for further investigation and report.

On the use of movable or fixed cranes the conclusion offered by the committee was: "Jib cranes attached to outer posts alongside of a number of pits in roundhouses, or, in the case of large roundhouses, a trolley hoist working around the outer circle, capable of handling two tons, should be installed in such roundhouses as may be designated by the motive power department as requiring such appliances for light locomotive repairs." The committee asked that this be substituted for the present paragraph in the Manual on the subject of air hoists and portable goose-neck cranes. The conclusion was adopted and the matter of the substitution referred to the committee.

On the last topic—best arrangement of windows and roof lights, and proper ratio of light area to floor surface—two conclusions were offered, as follows:

(1) The disadvantages of roof lights in roundhouses are so much greater than their advantages as to make them undesirable.

(2) Windows in the outer walls of roundhouses should be made as large as practicable and contain the largest glass or light area consistent with the requisite strength. In general, the lower sill should be not more than 4 ft. from the floor, and only sufficient space left between pilasters and sides of window frames, and girders and window heads, to properly secure the window frames. Windows or transoms as large as practicable should be provided over all doors where locomotives enter.

Both were adopted without change.

Iron and Steel Structures.—The report of the sub-committee on Impact Tests was presented first. There was no discussion.

The first subject considered in the regular report was Classification of Bridges as to Safe Carrying Capacity. The five conclusions of the committee were included in the synopses of reports printed last week. Mr. Greiner (B. & O.), Chairman of the committee, in presenting the report said: "The committee considers this question of safe carrying capacity of bridges one of the most serious problems which have been placed before it. The determination of what is the maximum load which can be operated over an old bridge is a question of serious moment. We have had some difficulty in coming to any positive conclusions, that is, conclusions which can be shaped in such manner as to be worthy of presentation to the association. One difficulty is the manner in which different engineers are accustomed to analyze a structure. Some will take impacts in considering the unit strains, others will not; and when one engineer says that he will allow a strain of 15,000 lbs. per sq. in. and another one says 26,000 lbs., there is ambiguity and it needs explanation. In our report we have followed the analysis that is outlined in our bridge specifications, wherein unit stresses are based upon the assumption that impacts are being taken care of in the enlarged stresses. That will account for the apparently high unit stresses mentioned in our conclusions. In presenting these conclusions we do so with considerable hesitation. There is a fear that they may be misinterpreted or misquoted or misused. We have therefore prepared an additional conclusion, No. 6.

"(6) It is of the utmost importance that the carrying capacity of a bridge be determined only by a bridge engineer of sound judgment and experience in similar questions, and the foregoing conclusions are based upon this assumption."

The first three conclusions were adopted without much discussion. No. 4 read, "When the span is less than 200 ft., all controlling factors given in Article 2 good, the mathematical analysis made in accordance with the American Railway Engineering and Maintenance of Way Association specifications of 1906, using full specification allowances for impacts for regular service fast speed, and one-half of these impact allowances for slow speed, then, so long as the controlling factors remain good, unit strains in tension to the extent of 26,000 lbs. in structural open-hearth steel and 22,000 lbs. in wrought iron, will not, in themselves, be sufficient justification for suspending traffic or condemning the structure." The question was asked, what was meant by "slow speed," and this brought on a long discussion on the advisability of stating at what speed the reduction in impact allowances should occur. The committee thought it should be left to the judgment of the bridge engineer, this being one of their reasons for proposing conclusion No. 6. Some members thought the clause might be changed to make the reduction in impact allowance proportional to the reduction in speed. The paragraph was finally amended by striking out "slow" and making the clause read "for speeds not exceeding 15 m.p.h."

Conclusion 5 was adopted without discussion, and the new conclusion, No. 6, likewise.

The next topic was Classification for Operating Purposes, and the conclusion, recommending the acceptance of the plan outlined, was adopted.

The portion of the report on Inspection, Reports and Records was referred back to the committee for further consideration, at its request.

A topic considered by the committee, not mentioned in the report, was the length of flat spots on wheels. Chairman Greiner explained that the length of flat spots causing the rejection of a wheel by the rules of the M. C. B. Association is 2½ in. The effect of such a spot on a wheel under a 100,000-lbs. capacity car, moving at high speed, is very bad, and it has been recommended that the M. C. B. rule be changed to 1¾ in. The question has been considered by the Executive Committee of the M. C. B. Association and the subject referred to the Arbitration Committee of that association, with instructions to confer with a committee from the American Railway Engineering and Maintenance of Way Association. President Johnston designated the committee on Iron and Steel Structures to act in the matter.

A sub-committee was appointed, A. J. Himes (N. Y. C. & St. L.) being chairman, and he presented a progress report. At its conclusion he spoke of a design prepared by Prof. Benjamin, of Purdue University, for apparatus to determine the effect of flat spots. As the latter was present in the convention when the report was presented, the courtesy of the floor was extended to him for the purpose of describing the proposed method of test.

Ballasting.—The conclusion to this report, asking the adoption of the ballast sections for crushed rock, was accepted, after explanation by the chairman of the committee regarding the recommended change of slope from 1½ to 1, adopted last year to, 2 to 1

Wooden Bridges and Trestles.—This committee had framed a conclusion asking the approval of the Standard Specifications for Bridges and Trestle Timbers as good practice. But since its report was put in type, the announcement was received that on January 22 the Yellow Pine Manufacturers' Association adopted, with but slight modification, the Specifications for Structural Timber adopted September 1 by the American Society for Testing Materials. A committee was also appointed to confer with committees of the American Institute of Architects, the American Society for Testing Materials and of the Maintenance of Way Association for the purpose of reviewing the specifications and adjusting differences. This action indicates a desire to co-operate definitely in the effort to secure uniform specifications. Therefore the committee desired to withdraw its conclusion and asked that the work be allowed to go over for another year. The committee gave in the report the differences between its specifications and those reported by Committee Q of the American Society for Testing Materials. The list was as follows:

GENERAL REQUIREMENTS APPLYING TO BOTH GRADES.

Committee Q allow dead timber to be used.

Committee Q have no specification regarding wind.

Committee Q allow sawing ¼ in. scant from given size, with loss in area of from 4½ to 10½ per cent.

Committee Q permit loose knots, except within 4 in. of the edge of stringers.

Committee Q permit knots in the corners of posts.

GRADE NO. 1.

Committee Q permit 5 per cent. less heart in stringers.

Committee Q permit knots over 2½ in. in stringers, if not within 4 in. of the edge.

GRADE NO. 2.

Committee Q require no limit to sap.

Committee Q do not give an alternative wane on two corners of stringers.

Committee Q allow knots up to 4 in. in 16-in. sides, and 3 in. in 12-in. sides, for stringers, caps and posts.

The convention was asked to discuss these differences in order that the committee might know its attitude relative to the various points of difference. The points were therefore taken up one at a time. Much time was occupied by this discussion. Dr. Herman von Schrenk, who is a member of the American Society for Testing Materials, as well as of the Maintenance of Way Association, was present, as was also Prof. Hatt, of Purdue University, and both gave full and valuable information on the points discussed. The net result of the discussion was that the convention expressed agreement with Committee Q on three of the five points under the first heading —General Requirements Applying to Both Grades—disagreeing on the first and fourth. It approved both points under the second heading, and disapproved the second and third points under the last heading.

The committee asked that the Revised Specifications for Piling be referred back for further consideration.

The matter in the report on Ballasted Floor Bridges was offered as information. The portion on Safe Unit Stresses was offered as a progress report, as was also the portion on the Preservation of Structural Timber.

A list of standard names for structural timbers was submitted, being the same as submitted last year. No change was made from the previous year, it having been decided from the year's investigations that no change was justified. In discussing the difficulty of distinguishing long-leaf, short-leaf and loblolly pine, Dr. Van Schrenk exhibited a number of samples of the last named, which, while true loblolly, in some cases were impossible to distinguish from other kinds of pines.

Two definitions were adopted, as follows:

(16) Ring Shake.—An opening between annual rings.

(17) Through Shake.—A shake which extends between two faces of a timber.

Track.—The first conclusion recommended that the elements of the split switch turnout from a tangent be computed according to the formulæ given in the report and as indicated by the table which had been worked out for various kinds of frogs. Objection was made that the formulæ contained errors; it was also suggested that the frog angle should be deduced from the sine rather than the tangent. A motion was therefore made that the frog angle be determined by twice the sine of half the angle divided into the radius; but after some discussion it was put to a vote and lost.

Mr. Cushing objected to the table containing such a large number of switch rails, there being seven. He therefore moved that the conclusion be referred back to the committee.

Mr. Stevens (P. & R.) thought the committee's method of getting the switch angle would introduce an appreciable error, as it assumed the switch rail to come to a point. There were other objections to certain features of the table, and after considerable discussion of these points Mr. Cushing's motion to refer back was adopted.

Conclusion 2 asked the adoption of the design of reinforced split switch shown in the report. Mr. Cushing thought it would be better if the committee prepared a specification rather than individual designs, and other members supported this view. The discussion was extended, and ended in referring the conclusion back to the committee.

Conclusion 3, asking the adoption of the frog design, was likewise referred back. The chairman of the committee called attention to the fact that the design showed a bolt at the end of the rigid wing rail, and he expressed the hope that members would incorporate this in their frog practice, as it would save money and much tightening of bolts. Some slight criticism of the design was offered before it was referred back.

Conclusion 4 was on the guard rail. The principal point of discussion was the clearance, which was put at 1⅞ in. The American Railway Association standard is 1¾ in., although many roads use 1⅞ in. Some members were in favor of making 1⅞ in. the standard of this association. It was pointed out, however, that this should not be done without conferring with the M. C. B. Association, as the latter's standard gage-points are made for a 1¾-in. clearance, and this, of course, is supported by the American Railway Association. A motion in favor of the 1⅞-in. distance was lost and the conclusion was referred back to the committee.

Nos. 5 and 6 were passed and No. 7 taken up. This had reference to the widening of gage on curves. The chairman explained that there was an error in the table calculations. The tables were therefore received as information. Mr. Ewing asked the committee what was the maximum excess gage it would be safe to have. The committee was unable to say, stating that it would be necessary to make some experiments on the effects of four-wheel trucks on widened gage before they would know.

Rail.—The committee asked the adoption of the conclusion to the report, which recommended the adoption of the form M. W. 1200 for reporting rail failures.

Mr. Cushing had made to the committee some suggestions for rearrangement of the form, and while these were not presented to the convention, he requested that they go into the Proceedings as a part of the discussion. The conclusion offered by the committee was adopted.

Yards and Terminals.—The Recommended Principles of Practice for hump yards were taken up first. As the first ten of these were practically the same as already indorsed and published in the Manual, they were passed without discussion, except No. 8, which provided for an air-brake testing plant in the departure yard. Mr. Rhea (Penna. Lines West) told of a plant being put in the receiving yard of the P., C., C. & St. L. at Logansport, Ind., at the request of the master mechanic, and they are well satisfied with it. After some explanation of the advantages derived, he made a motion that the conclusion be amended to include the receiving yard as well as the departure yard. The motion was adopted.

Conclusion 10, specifying the grades for the hump, was adopted, as were Nos. 11 and 12. Some members asked if the latter conclusion meant raising and lowering the track for winter and summer conditions. The chairman explained that it merely recognized that a higher hump is needed in winter, and where a hump is built for summer conditions it is necessary to raise it for winter conditions.

In No. 13, providing for a track scale, a space of 30 to 40 ft. was recommended as the distance it should be put from the sum-

mit. Objection was raised to this distance, some members thinking 90 ft. was better. A motion to strike out the reference to distance was carried, the conclusion then being adopted without other change.

No. 14, recommending that a No. 8 frog be the sharpest used in classification yards, was adopted.

The report stated that it had been suggested to the committee that 1,200 cars to be classified in 24 hours should be the minimum limit in a hump yard. Mr. Pfeifer (T. R. R. of St. L.), of the committee, who had made the suggestion, explained that hump yards require large switching crews on account of the great number of riders. A crew sometimes contains 18 or more men. Such a crew, to be economical, must be employed constantly. If there are fewer cars than that to be switched, the rate of switching will leave a large amount of idle time on their hands. His company has on its lines an ordinary gravity yard in which from 60 to 70 cars can be switched with a crew of three switchmen and an engineer and fireman. They have switched as many as 1,100 cars in one day, and the car breakage is not excessive. Having switched the cars that ought to be switched, a small crew can do some other yard work in addition to classifying, but there is no other kind of yard work which would require such a large crew. It was, therefore, as a measure of operating economy that the suggestion was made.

The conclusions on Yard Lighting were adopted without discussion, and also those on Freight Transfer Stations. However, questions were asked about the last one of the latter, reading, "where large amounts of freight are to be transferred, the use of power-driven covered traveling platforms, instead of fixed platforms, is suggested." The committee stated that, so far as they knew, no such installation had ever been made, except that something of the sort had been used as an emergency measure and worked well. It was therefore thought well to submit the idea to the association.

It was decided that this conclusion, and the one following it recommending freight handling machinery as being worthy of consideration, should be omitted from the Manual of Recommended Practice.

Roadway.—The conclusions on grade and curve improvement work inside cities, such as track elevation and depression, were considered first.

The first was on Organization. Objection was made to the provision of a special trainmaster and despatcher, as it was thought such matters could be handled better by the regular officers. The committee explained that it was the intention that the work should be handled entirely separately from the regular operation, assuming, of course, that it was large enough to justify such an organization; this had reference only to the territory covered by the work, as stated in the conclusion. The conclusion was therefore amended to have this part read: "A trainmaster, with a despatcher, in charge of the operation of traffic over the territory covered by the work in hand, may sometimes be required." With this change the conclusion was adopted.

No. 2 related to the handling of the work. J. A. Atwood (P. & L. E.) suggested that the paragraph should only distinguish between the work to be done by the company and that to be done by contract, omitting any reference in detail to the kind of work. He therefore moved to amend the conclusion by striking out such references, making it read:

"(2) The railroad company should handle with its own force all work which may interfere with the operation of the road. All other work which can be done without material interference with the operation of the railroad may be let by contract."

No. 3, reading "As far as practicable, all earthwork should be handled by machinery; that is, loaded by steam shovels and unloaded by plows, handled by cable unloaders and moved by spreaders," was amended by striking out everything after "machinery."

Objection was made to No. 4—"The best material to use for filling is sand"—on the ground that it was too sweeping to go into the Manual, which goes to all countries. And while it was admitted that sand unquestionably is the best material, it would be better to name the qualities which the best material should possess. Mr. Byers (Mo. P.) therefore moved to substitute for No. 4 the following: "The best material to use for filling is that which combines low first cost, ease of handling and stability."

This was adopted.

The last two were adopted without discussion.

Grade and Curve Improvement Work Outside Cities was next considered, there being nine conclusions. No. 1, reading "Establish the lowest gradient and lightest curvature which physical conditions and the present and prospective business of the road will admit," was adopted after changing "admit" to "warrant."

Nos. 2, 3 and 4 were adopted without change. No. 5, reading "Eliminate temporary bridges, etc., by the substitution of permanent structures in concrete and steel, wherever it can be done, having in view the formation of a continuous roadway on ballast," was amended by striking out everything after "structures."

No. 6 was accepted without change, and No. 7, which read "Provide separate tracks for work and traffic, wherever it can be done," was changed to read "Provide separate tracks for work and traffic where conditions warrant."

No. 8 was not changed. No. 9 was on organization: "The simplest organization is the best. Some one man should be in responsible charge of the work, with a staff of engineers under him, and enough supervisors to cover the work, who have full control of men, material and means for each section, with foreman and gangs wherever needed." The last nine words, arter "means," were changed to "necessary for the sections respectively under their charge," and the conclusion adopted.

Some criticism of the form of the conclusions was offered during the discussion. After their adoption by the convention the following resolution, offered by Mr. McDonald (N. C. & St. L.), was adopted: "Resolved that the committee be requested to recast the language of the conclusions so as to make them suggestive instead of mandatory, before publication in the Manual."

Masonry.—The committee had been instructed to revise the specifications for stone masonry and present them for final approval. As the changes made were slight, the specifications were indorsed by the convention without reading. No other matters in the report were considered.

Records, Reports and Accounts.—The conclusions on right-of-way maps were considered first.

The definition was adopted with one slight change in wording.

Conclusion No. 1 was adopted after adding the portion printed below in italics, and omitting the word "all" before "permanent."

(1) Right-of-way maps should show the state, county, township, town or city; the right-of-way alinement complete, *with particular reference to, and with suitable notation of, short and long stations;* the station plusses of the crossing of all important land or property lines and streets, with the distance to all permanent land or street corners; the angle which the center line of the road makes with property lines; the number of the right-of-way sheet; the points of the compass; the scale and date of the map; the boundaries of the several parts of the land owned by the company, and the width of the right of way, particularly at those points where the widths change; any additions of subdivisions of towns or cities, with numbers and sizes of lots and blocks and names of streets. It should also show all main tracks, side tracks and structures that were built in connection with the original construction of the road; the exact location of all crossings of steam, electric or other roads.

Conclusion No. 2 read: "On or near each part of the land on the right-hand side of each map should be shown the deed custodian's number; the name of grantor and grantee; mile posts, kind of instrument, date and book and page where recorded. This also includes reference to leases, franchises, ordinances and grants concerning the use of land." The words "references to" were inserted before mile posts.

No. 3 was amended by striking out the last six words of the following, as indicated by brackets:

(3) The original right-of-way map should be traced, and the tracing filed away for a permanent record of the conditions existing at the time the railroad was completed. The map from which this tracing is made should be corrected from time to time as changes are made in important tracks and structures which are of value as reference to the right-of-way boundaries, as well as any transfers of property made to and from the railroad company [and any important tracks or structures].

No. 4 was likewise amended by striking out the final six words:

(4) The property of adjacent railroads or of subsidiary and associated companies should be shown in different colors [for the purpose of ready distinction].

No. 5 was amended by striking out the portion shown in brackets:

(5) It is important to show on the original right-of-way map a profile of the same horizontal scale and of the same station numbers as the map, and of suitable vertical scale, which profile should show the original sub-grade, the location, character and size of opening of each bridge, waterway or under crossing and the original surface of the ground [the necessity for this being the knowledge of physical conditions at the time the road was built, often needed in defending litigation and settling questions arising from time to time].

No. 6 was adopted without change. An effort was made to have definite scales stated in this conclusion. The chairman of the committee explained, however, that, after a thorough consideration of the matter in the light of information concerning what scales it was practicable and impracticable to use in different parts of the country, it would be impossible to recommend a scale that would meet the views of a majority of the members.

The conclusions on track maps were amended as follows:

Definition—"Track Map.—A map used primarily for showing physical conditions, including tracks, bridges, buildings, water service and mains, leases, station facilities and all of the physical and operating features."

The word "existing" was inserted ahead of "physical conditions" and "other" substituted for "all of the" in the latter part.

Several changes were made in the first conclusion.

(1) Track maps should show all physical conditions pertaining to the construction and operation of the railroad and the limits of the right of way without reference to title or ownership. They should show all main and side tracks and their alinement, distance between them, capacity in car lengths; all buildings upon the right of way and adjacent to main or side tracks; bridges, culverts, water stations, coaling plants, turntables, shop buildings, water mains, electric light wires, fences, street car and other railroad crossings, and the angle they made with the railroad track; sewers, signals of all kinds and all physical conditions on the property. All structures on such maps should be located by chainage numbers and plusses.

"Physical" was struck out in the first line; "cars" was substituted for "car lengths"; for "electric light wires" the words "conduits, wire lines of all kinds and their supports" were substituted; in the last sentence "all" was changed to "important."

No. 2 was amended by striking out the portion shown in brackets:

(2) They should be corrected whenever any changes are made in any of the features shown thereon [and a corrected copy sent to the general office for record].

No. 3 was amended by striking out the words "and cities."

(3) It is recommended that a scale of 100 ft. to the inch be used for such maps except in territories and cities of large industrial development, where varying scales may be used to suit the local conditions.

No. 4 was amended by striking out "very" and substituting "meridian" for "north point."

(4) The map should show very plainly the north point, scale, original date and date corrected.

No. 5 was amended by striking out "always," "it is" and "to do so":

(5) The conventional signs adopted by the association should always be used where it is possible and convenient to do so.

Mr. McDonald (N. C. & St. L.) asked if on maps of 100 ft. to the inch the tracks should be shown in double or single lines. The committee had not considered this and were instructed to make a suggestion concerning it in their next report.

Under Individual Ledger Accounts there were two conclusions asking the adoption of the forms recommended. These conclusions were adopted, following suitable explanation by the chairman of the committee concerning the forms.

Ties.—There were two conclusions to this report which were adopted without discussion. They were:

(1) That the method for analysis of coal-tar creosote shown on pages 98-101 of Bulletin 96 be approved as good practice.

(2) That the method of determination of zinc in treated timbers shown on pages 102-105 of Bulletin 96 be approved as good practice.

The committee on Signs, Fences, Crossings and Cattle Guards and Economics of Railway Location made progress reports.

Car Surpluses and Shortages, March 4.

The following table is from bulletin No. 19 of the American Railway Association's Committee on Car Efficiency. It summarizes the car surpluses and shortages from October 30, 1907, every two weeks to March 4, 1908, inclusive, being similar to the table published in the *Railroad Gazette* of February 21, 1908, with the figures for February 5 revised to include reports later received.

The improvement in the general situation first noted on February 19, 1908, is continued. On March 4 there was a further reduction of 7,521 cars in the idle equipment, making a total decrease in the idle cars since February 5 of 28,936 cars, or 8.4 per cent. On February 19 there was a marked improvement in the demand for coal cars, but this appears to have been checked, and on March 4 there was a slight increase in the surpluses of this class of equipment. On the other hand, there is an encouraging reduction in the number of surplus box cars. There is a fair decrease in the surplus flat cars, while the surplus of miscellaneous cars remains little changed. It is worthy of note that every marked change in the situation since the maximum shortage of October 30, 1907, has first shown itself in the figures for box cars.

The greatest percentage of decrease of surplus equipment was in the Canadian group, although the largest numerical reduction was in the Northwestern group. Both of these groups report smaller surpluses of all classes of cars. On the other hand, there was a continued increase in the surpluses in the Southern, Central, Western and Southwestern groups. The Middle group, although showing less surplus box and flat cars, reports an increase of idle coal and gondola cars which more than offsets the decreases, making a net increase in the total surplus of all classes of cars for that section.

SURPLUSES AND SHORTAGES BI-WEEKLY FROM OCT. 30, 1907.

		Surpluses.					Shortages				
	Number of roads.	Box.	Flat.	Coal, gondola and hopper.	Other kinds.	Total.	Box.	Flat.	Coal, gondola and hopper.	Other kinds.	Total.
March 4, 1908	162	103,905	27,232	139,223	44,632	314,992	943	19	600	57	1,619
February 19, 1908	161	113,776	30,088	134,217	44,432	322,513	697	141	249	162	1,249
February 5, 1908	158	112,046	30,312	156,634	44,936	343,928	737	281	15	67	1,100
January 22, 1908	161	124,622	27,328	142,338	48,292	342,580	392	132	79	135	738
January 8, 1908	163	149,664	23,087	127,138	41,874	341,763	457	34	42	120	653
December 24, 1907	158	87,714	14,740	64,556	42,300	209,310	187	81	191	265	724
December 11, 1907	153	48,977	9,888	27,462	33,012	119,339	2,506	420	746	848	4,520
November 27, 1907	160	16,246	3,645	10,028	10,429	40,348	11,908	868	2,964	2,224	17,964
November 13, 1907	164	4,103	1,208	2,365	4,525	12,201	37,473	3,066	10,914	5,550	57,003
October 30, 1907	161	786	600	1,285	1,275	3,946	61,592	3,546	15,987	9,632	90,757

The Strength and Endurance of Steel Rails.*

BY JAMES E. HOWARD,
Engineer of Tests, Watertown Arsenal.

In the use of steel rails, as with other materials of construction, interest is directed to the limiting values of applied stresses, their accurate definition, and how closely they may be approached with safety under those conditions of service to which the materials in question are to be subjected. In the constructive arts are found examples of steel exposed to stresses of different kinds and in varying degrees of intensity, but it is not recalled where there is greater diversity of action than is found in the case of steel rails. The whole gamut of conditions are here present in the same piece of metal; and an unusual feature is the fact that the stresses are received on so limited an area of contact on the rail head. The feature of intense local pressure between the wheels and the rail is an important one, and one which does not allow the adoption of those corrective measures which can be applied to other features of the rail question.

Tests have been made on rails at the Watertown Arsenal Laboratory in earlier years. At present a series is in progress which was begun in connection with the current study of ingots and derivative shapes. The laboratory is co-operating with, and is being aided by, members of this association and others.

In the earlier work of the laboratory, the tests comprised rails of domestic manufacture, some of the early English rails, and one or two examples of French and German make. Many of these had been in service. The tests showed that rails from the track were generally less tough when loaded so that the head was in tension; in fact, they were quite brittle, and fractured after comparatively little permanent deflection. By planing off metal from the running surface of the head, the rail was restored to a tough condition, and then bent well with either the head or the base on the tension side. Planing off one-eighth inch of metal was sufficient, but it was necessary to remove all of the affected metal, which included some from the sides as well as that from the top of the head. Restoration of toughness was also accomplished by annealing the rail, without planing off any of the metal.

This loss in toughness is due to the flow of metal under wheel pressures. It will, of course, take place promptly and quite easily in the softer grades of steel. From this point of view, a soft steel has the disadvantage of low strength and is not free from brittleness, in spite of the inherent toughness of the metal. The original properties of such steel are apt to be misleading and encourage greater confidence in its ductility than is warranted by its subsequent behavior. It does not follow, however, that the initially harder steels will not also become more brittle at the running surface of the head of the rail, since all grades of steel are probably affected in this manner by wheel pressures under present practice. It is not known whether present service conditions are such as to allow the metal at the surface of the head of the rail to retain its original tensile properties unimpaired until lost by abrasion and wear. In the harder rails, the depth of the affected metal is thought to be less than in the softer rails; still, the depth is appreciable and has an influence on the toughness of the steel.

Loss of ductility is due to the flow of the metal of the surface of the head and not directly to the high compressive stress between the wheel and the rail. Other tests have shown that high compressive stresses unaccompanied by relative displacement of the metal do not change the physical properties as evidenced by subsequent ten-

*A paper presented at the ninth annual meeting of the American Railway Engineering and Maintenance of Way Association. Read by J. P. Snow, Bridge Engineer, Boston & Maine.

sion tests. High compressive stresses of this kind may be applied in tests by cubic compression, specimens being immersed and subjected to hydrostatic pressure up to 100,000 lbs. per square inch.

Alternate tension and compression tests have shown that overstraining in either direction lowers the opposite elastic limit; that is, a tension load applied in excess of the elastic limit has a detrimental effect on the compressive elastic limit, materially lowering the latter value. On making similar tests with rails, but loading them transversely instead of by direct tension and compression, it was found that the application of a high load—one causing decided permanent sets—resulted in lowering the elastic limit of the rail when it was reversed in position and loaded in the opposite direction. Examination of a rail 14 months later did not show a restoration from this disturbed state during the interval of rest. Repeated reversals resulted in lessening the magnitude of the deflection sets, over the first sets, an effect which would pass as a stiffening of the rail, in common parlance, although the modulus of elasticity of the steel is lowered by over-straining of the metal. Bringing the metal to a red heat brought about a partial restoration, but did not fully return the rail to its original condition as regards the development of sets. The effect on the surfacing of the track from overloading a rail is apparent from these results.

Since the cold straightening of a rail at the time of manufacture is another illustration of loading beyond its elastic limit, similar results to the above are certain to follow. A rail thus straightened is left with initial strains in equilibrium when the rail is without a load, but such as to develop sets in the track upon the application of very moderate loads. The opposing internal strains augment the effects of the wheel loads and facilitate early sets. Surfaces of metal first to cool from higher temperatures are left under initial compression, and this tends to further complicate the condition of the rail.

The lines of magnetic scale which leave the rail in the vicinity of the gagged parts show where the steel has been overstrained locally. Unless the metal is structurally unsound in the paths of such lines, no unfavorable results of the gagging would be immediately expected. The number and magnitude of repeated stresses necessary to cause rupture of the steel would be such as to relieve anxiety as to early failure of the rail from this cause, although this action, such as it is, is detrimental. While a given effect is more easily produced in a soft steel rail than in a hard one, on account of the difference in strength, yet a slight defect existing in the hard metal is of greater consequence than in the softer metal.

Seemingly minor and accidental causes may lead to early rupture. Some are so slight as the abrasion of the base by a spike or an indentation of the flange by a chance hammer blow.

In deciding on the cause of rupture, the line of fracture should be traced back to its beginning. Fortunately in steel fractures this may generally be done. A well defined nucleus marks the origin of a granular fracture, from which a fan-like or radiating pattern diverges. It is usually possible also to tell the order in which the fractures occurred, when more than one surface is presented, by inspecting the fractures and noting their appearances as above indicated. In this way rail fractures might be exhibited in which the first break detached a moon-shaped fragment from one flange, having its origin near the middle of the base, followed by a secondary fracture separating the other flange and extending up through the web and then through the head; fractures beginning at one edge of the flange, extending across the base and thence through the rest of the rail; fractures beginning at a bolt hole and extending each way until the fracture is complete; or fractures having their origin at the running surface of the head and extending downward through the rail.

The flow of the metal under wheel pressures is one of the most important of the causes of fractures. Whatever may be done to strengthen the rail in other respects, the fact still remains that the load is applied on a very limited surface of contact. This obstacle is insuperable and imposes a limit on the size of concentrated wheel loads.

The influences enumerated tend to develop fractures in rails structurally sound and with good physical properties, but it is recognized that rails are not always free from structural defects, although they may have satisfactory tensile properties. Some of these defects are serious and apparently have led to a considerable number of fractures in recent years. It has been found in a number of rails examined that longitudinal streaks are present in both the head and in the base, streaks of a different color from the adjacent metal as they appear when etched with tincture of iodine. Some of

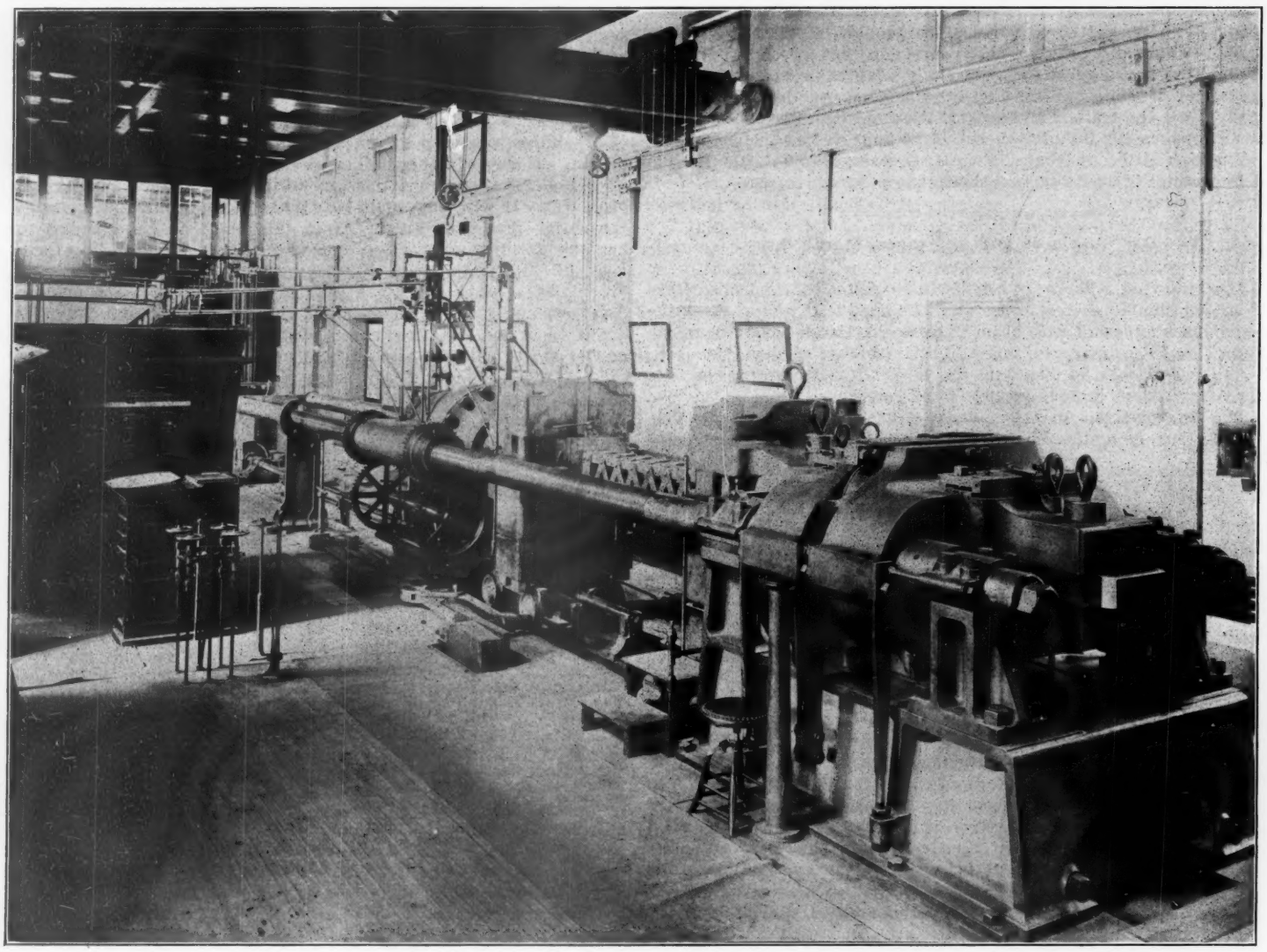


Fig. 1—Portion of the Shop Where Tests Were Made.

In front is the old Emery testing machine of 800,000 lbs. capacity. There is a latticed column in the machine arranged for a test by compression.

the streaks are several feet long, others a few inches or only a fraction of an inch in length. They are of different widths, from a few hundredths of an inch to upwards of an eighth of an inch, and not infrequently have a fine hair line or crack along the middle. The cracks are commonly short, less than an inch, and in depth penetrating the metal but a few hundredths of an inch. They are, in some rails, quite numerous, and in planing the metal away for examination new hair lines appear in succession as those first in view are planed away. The steel fractures without elongation when ruptured by stresses applied at right angles to the direction of the cracks. That the streaks represent lines of weakness there is hardly a doubt, and their elimination, if practicable, is desirable and would be of advantage to the rails. The development of moon-shaped fractures may be traced to streaks or hair cracks in the rail at or near the surface of the base. It is of deep interest to discover the causes of these lines of structural unsoundness or lack of continuity and the means by which they may be avoided, if such is possible.

These streaks and fissures are not a recent development. They are found in rails of early manufacture, and even more pronounced than is general in rails of current make. Examination of a number of early English rails shows streaks and fine cracks. They have been found in rails of domestic make from different mills, and in a sufficient number to show that their presence is not restricted to any particular make. It does not seem, however, that all rails from the same mill are equally affected. There are wide differences among them, although it may be difficult to find those which are strictly sound throughout.

There is urgent need of information as to the state of the metal in the ingot and through each successive stage to the finished rail. In this inquiry, all the metal from the several ingots comprised in the series of tests should be available for examination. This has reference to the metal usually discarded from the ingot, and to crop ends of the rails, which should be comprised in the tests as well as the portions of the ingots made use of in the rails.

These rail tests are included in the general series of ingots and derivative shapes, previously mentioned, in which the laboratory is aided by the following committee: Major C. B. Wheeler, Commanding Officer, Watertown Arsenal (ex-officio); J. E. Howard, Engineer of Tests, Watertown Arsenal (ex-officio); William R. Webster, Consulting Engineer; Edgar Marburg, Professor of Civil Engineering, University of Pennsylvania; James Christie, Consulting Engineer; Charles B. Dudley, Chemist, Pennsylvania Railroad; E. P. Kenney, Metallurgical Engineer, Cambria Steel Co.; J. P. Snow, Bridge Engineer, Boston & Maine; A. A. Stevenson, Superintendent, Stan-

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 2. Section of an 8 in. x 8 in. bloom (view is foreshortened). The spotted circle of darker marking will be noticed. Bloom was reduced from ingot about 20 in. square. Section of the ingot before reduction was examined, but no markings such as are shown on the blooms were brought out by etching. Fig. 3. Subsequent stage in the reduction of a portion of same bloom, in the roughing rolls. Fig. 4. Still further reduction in the roughing rolls, markings in cross-section becoming a little more pronounced. Fig. 5. Cross-section of finished rail from same ingot. The familiar lines often seen in rails are shown on this section.

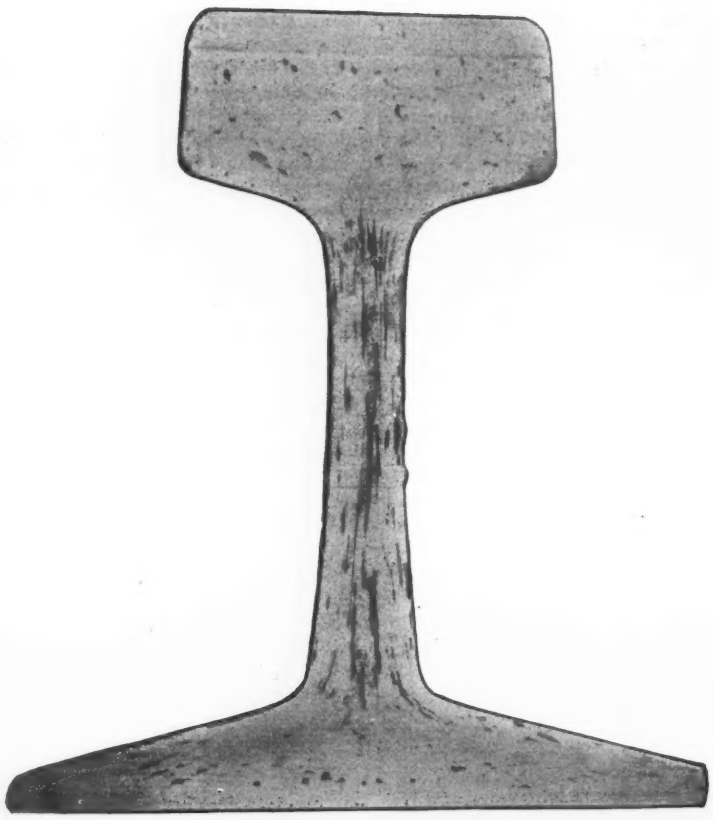


Fig. 6.

Fig. 7.

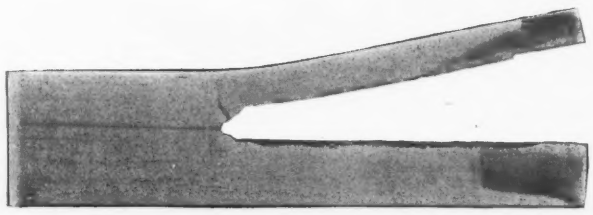


Fig. 8.

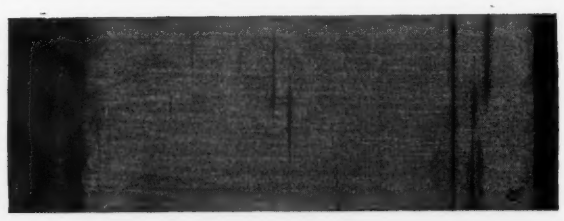


Fig. 9.

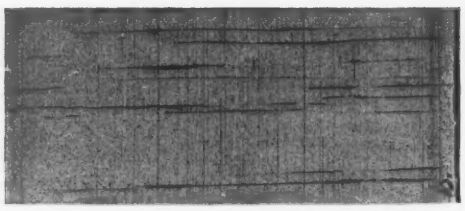


Fig. 10.

Fig. 11.

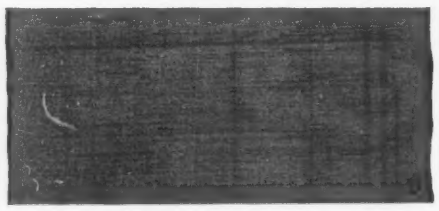


Fig. 12.

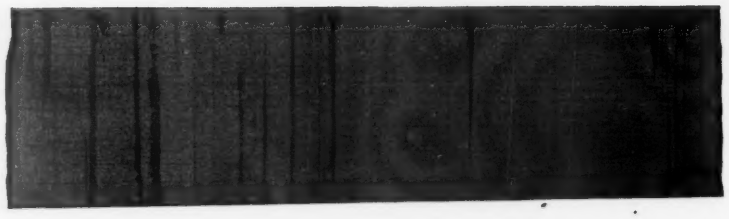


Fig. 13.

Fig. 6. Cross section of 100-lb. rail. Familiar markings brought out by etching are here shown as in the earlier slide. To find out how bending qualities of the metal at these dark streaks and patches compared with the lighter portions of the metal, a thin section of the rail, taken in cross section was slotted off and bent along the lines of the dark streaks and over the patches. Fig. 7. Results of bending the thin section are here shown, but imperfectly because of the deflection of light. On bending these thin strips, fractures occurred more easily over the dark streaks and patches than over the white portions. The section of the web was bent about a vertical axis and rupture occurred along one of the dark streaks. The edges of the top side of the base were bent over where dark blotches occurred and fracture occurred in these blotches. The head was also bent about a vertical axis and it ruptured in the dark lines.

Fig. 8. Web of a rail in horizontal section, looking down on the central streak. The streak of dark metal extended through the depth of a piece of web which was cut off. Structural weakness along this dark streak was not enough, however, to allow the section to be split along the streak. The specimen was sawed into, and on wedging the prongs of the forked-shaped end apart, the metal fractured transversely instead of splitting along the streak. Fig. 9. Shows some streaks and hair-lines on the head of the 100-lb rail. Lines run longitudinally. Rail was prepared by planing off about $^1/_{16}$-in. from running surface of head, smoothing the metal with file and emery cloth, and then etching with tincture of iodine. Fig. 10. Short section of base of same rail. Dark lines run longitudinally, as, in fact, all such lines run. Finer lines running crosswise are those left by the machine tool or the file. Fig. 11. Photograph of a part of the head of the rail shown in Fig. 21. Streaks here shown are typical white streaks. Along the middle of some of these streaks, hair-lines or cracks are evident, in which there is plainly a separation of the metal. In all white streaks examined with a high-power microscope, cracks at some points are found. A well-defined crack will usually pinch out to a series of very short cracks, exactly in line, but perhaps only a few hundredths of an inch long. After these there may occur clusters of minute holes, four or five together, hardly discernible under 200 diameters. Following this, the white streak will show, looking like a pathway irregularly strewn with light-colored gravel. The white specks are not rounded, but seem to be little chips, which might be cut by the polishing grit and caught on the fibers of the adjacent steel The white metal looks softer than the ordinary metal surrounding it. This, however, may be only an appearance. Fig. 12. Streaks in head of early rail made by the Landore-Siemens Co. They appear to be of the dark variety. Fig. 13. Base of same Landore-Siemens rail.

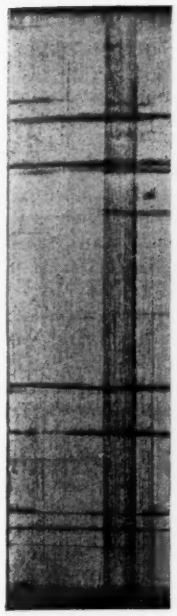


Fig. 14.

Fig. 15.

Fig. 16.

Fig. 17.

Fig. 18.

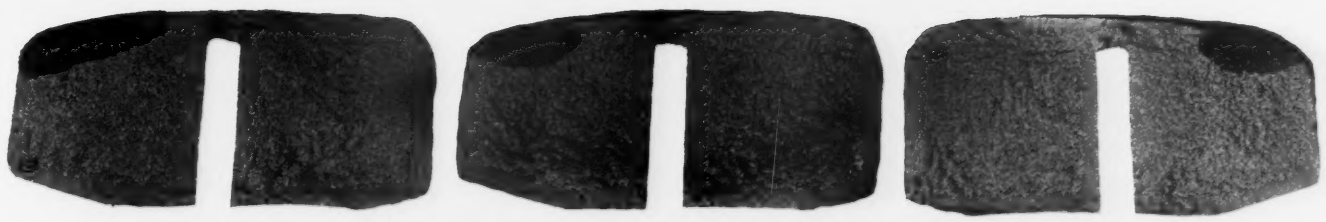


Fig. 19.

Fig. 14. Streaks in base of a John Brown rail (early English). This and preceding illustrations may be taken as typical as regards longitudinal streaks. Though those selected show more streaks than others, streaks are certainly very common, and no rails have yet been found entirely free from them. Some rails which had given good service and had a good track record had fewer streaks than those which had failed in service. Moon-shaped fractures appear to originate in streaks like those just shown in the bases of rails. Fig. 15. Fractured rail, 5-in., 75-lb., which failed in track after nine years of service. Evidently a moon-shaped fracture. A piece was first detached from the flange, followed by a second fracture through the other flange and the rest of the rail. A radiating structure will be noticed in the fracture. The center of radiation marks the origin of the fracture. The primary fracture was clearly the one extending not quite half the width of the base. Fig. 16. Rail fractured in testing machine. Shows how slight indentation of the metal may locate fracture when tested to destruction. A chance hammer blow had slightly indented the upper right-hand edge of the flange. From this the fracture began. The radiating structure could be traced on the rail itself, but this is more obscure on the photograph. Fig. 17. Two pieces of rails, after testing. Both tests made from same rail, which had been some time in service. Effects of wheel pressures shown by flow of metal on the sides of the head. Tests show difference in strength which may be expected when a worn rail is loaded with the base in tension or the head in tension. The upper piece, loaded with the base in tension, sustained a maximum fiber stress of 146,700 lbs. per sq. in.; the lower piece with the head in tension, ruptured with fiber stress of 110,900 lbs. per sq. in. Lower piece deflected only 4½ degs. and ruptured; other bent 21 degs., the test being discontinued without rupture. Illustrates serious damage to the rail from flow of metal under wheel pressures. Fig. 18. Rail in which the running surface of the head has been seriously affected by the skidding of engine wheels. Effect of the drivers was to cause flow of the metal of the head, and also cause the development of transverse fractures at the corners of the head. Fig. 19. Fractures of the head of roughened rail (Fig. 18); incipient cracks, due to effect of wheels, shown by dark spots at the corners of the running surface. These cracks appear to indicate the limit of heavy loads for rails made of carbon steel.

dard Steel Works; S. M. Vauclain, Baldwin Locomotive Works; F. W. Wood, President Maryland Steel Works.

A number of lantern slides, prepared to illustrate some of the current work of the Watertown laboratory were presented and are reproduced herewith.

After exhibiting the slides, Mr. Snow discussed the probable cause of rail breakages, saying: The specimen which I now show you is the one shown by the last slide exhibited (Fig. 21). It has been planed, as you see, to different depths in the head and in the base. The surface where the planing is shallow shows prominent white streaks; one portion of the head being that shown on slide No. 11. White streaks appear in the deeper cuts, but they are generally not in line with those above, showing that they are diffused throughout the metal. As we get deeper into the metal, however, white streaks become scarce and finally disappear, but in this particular specimen the deeper cuts show dark streaks. These are not so definite in their widths as the white streaks, but they penetrate the metal somewhat more deeply, and show in the end section of the rail, whereas the white streaks do not show in this location. White streaks with their accompanying cracks lead to flange breaks and, perhaps, to split heads. Dark streaks appear to be the results of segregation and lead to crushing of the head. In addition to these two kinds of streaks, there is another defect which is not in evidence on this specimen, but which is very common in the rails rolled during recent years. I have previously called the cracks found in white streaks "gas seams." I called the defects which I am now describing "rolling flaws." The cracks of the gas seams are strictly parallel to the line of rolling and are straight. The plane of the cracks is, also, at right angles to the surface of the metal. The seams called rolling flaws are parallel to the rolling in a general way, but are usually somewhat crooked. They are similar to the flaws called snakes in plates, but in the case of rails, they are practically straight. The planes of these seams are generally inclined to the surface of the metal and their sides are fluted and usually of a bluish color, similar to mill scale, indicating that they were oxidized while the metal was hot.

The crescent fractures that I have examined have almost all shown their origin to be one of these rolling flaws, although occasionally the origin seems to be a gas seam, but my observation leads me to think that by far the largest number of recent breaks are due to seams of the rolling flaw type. The older rails examined, while they show plenty of white and dark streaks, do not exhibit the defects which I call rolling flaws; this, undoubtedly, accounting for the greater prevalence of flange breaks and split heads in rails of recent make.

In view of the fact that in all of the crescent breaks which I have examined—and that is a good many—it has always been possible to discover a manifest flaw from which the break started, and from the fact that Mr. Howard in his paper claims that this class of breaks are due to seams which are in the rails when they leave the mill, I claim that the case is fully proved that flange breaks, and perhaps split heads, are due to incipient flaws existing in the rails when purchased. It is a remarkable fact that the rail tests prescribed in our specifications do not in any way tend to develop these defects. I wish to recommend that tests be prescribed which will show whether or not these flaws exist.

Perhaps I ought to rest my case here, as it is all that has been fully proved. The temptation is strong, however, to make guesses as to what causes these defects. I stated, in a paper printed in Bulletin No. 93, that in my opinion the flaws here called gas seams were due to gas bubbles in the ingot. I still think so, but the flaws which I call rolling flaws appear to me to be due to shrinkage cracks, or checks in the ingots, or tears in the bloom, or perhaps the gas holes which are so near the surface of the ingot as to burst out in the soaking pit, due to softening the metal, or afterwards under the pressure of the blooming rolls.

If we go a little farther and try to investigate the cause of gas bubbles in the ingot, we get on more uncertain ground. Professor Howe, of Columbia University, claims they are largely due to mechanical action, the shrinking of the interior of the ingot tending to cause tension in the plastic metal, thereby relieving the pressure and allowing the formation of gas bubbles. The metallurgist of the Chicago Steel Co., Mr. Von Maltitz, in a paper read before the London meeting of the American Institute of Mining Engineers,

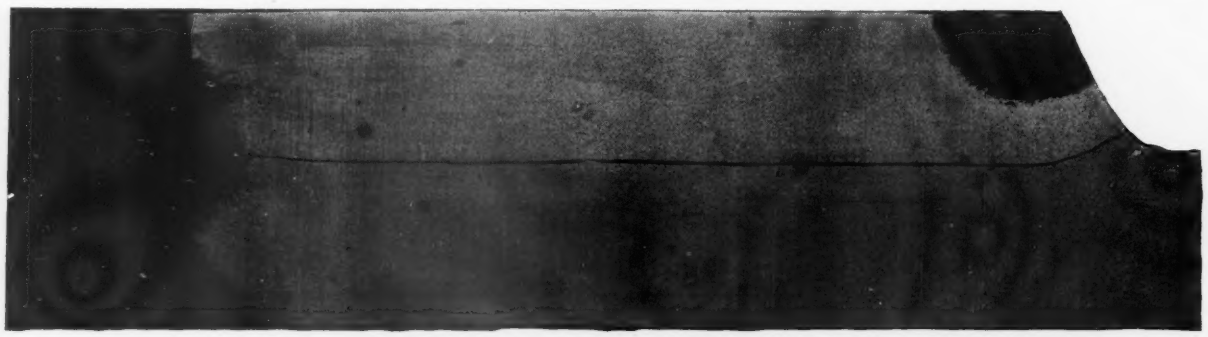


Fig. 20.

Fig. 21.

Fig. 20. View of under side of a rail, showing moon-shaped fracture made in testing machine. It was just beyond one which had been caused while rail was in track. The base of this rail showed characteristic streaks, such as were previously illustrated. Fig. 21. Piece of rail which has been planed down in successive steps, to show the presence of streaks at different depths in the head. The base of this rail was also examined and a section of the flange subjected to cross-bending, the cross-bending resulting in a brittle fracture along the line of a streak.

claims that they are wholly due to chemical and thermic action. Both of these investigators prescribe means of lessening the difficulty.

As to the cause of the cracks, etc., which lead to rolling flaws, the remedy is self-evident. Chipping ingots and blooms, as was formerly done, will remedy the shrinkage cracks, checks and gas holes. Less severe reduction in the blooming and roughing rolls will obviate tears, provided the metal is not unduly hot—short from excess of oxygen or sulphur.

Mr. Howard is on the trail of these defects. We ought to encourage him all we can to trace them to their origin, whether it be in the rolling, the ingot, the ladle or the bath.

William R. Webster spoke as follows on the work of the committee:

"Professor Marburg and I were called in to assist in this work by the ordnance bureau, and in order to make it representative work we had a meeting last October in New York, to which we invited about 40 engineers and manufacturers to meet Major Ruggles and Mr. Howard, of the Watertown Arsenal. Dr. Dudley, of the Pennsylvania Railroad, presided. Dr. Dudley was given authority by the meeting to appoint two committees, one committee on the compression tests and the other on the investigation of ingots, blooms, billets and slabs. The whole matter was brought up originally by a report of Mr. Howard to the ordnance bureau, suggesting an investigation of this kind and asking for a larger appropriation. The appropriation for this year's work is about $35,000, or about twice the amount received before. I am glad to say that both of the committees have fairly started on their work, and that there has been no red tape or anything of that kind to hinder us in the work. Some of the members of this association and some of the steel manufacturers are co-operating with us and furnishing freely samples of their material, including ingots and different finished products, and I have no doubt that other members and other manufacturers will call on them when they understand more clearly what they are doing at Watertown."

Mr. Howard sent me samples and wrote as follows:

"Mr. Snow will hand you a piece of the base of a rail which was fractured transversely and which shows a laminated streak of several hundredths of an inch in depth, and which occasioned a very short and brittle fracture. This piece was annealed before testing, for the purpose of seeing whether any reduction in brittleness could be effected by annealing the metal, but none resulted; that is, these streaks are a detriment, in spite of anything we can do toward softening the metal in which they exist.

"Another piece which Mr. Snow is kindly bringing out to you is a thin slice from the base of a 100-lb. rail. There were a number of streaks in one end of this sample. Bending transversely opened one of these seams you will see; the other end was also bent transversely and opened up some short cracks. When bent in the other direction, across the middle of the length of this piece, the bending qualities were much better and no fractures were caused. These two samples are the best I can do; they are not precisely what you may have preferred, but I did not have time to get out other pieces similar to those which we exhibited at the New York meeting."

A. A. Stevenson in discussing a paper by Mr. Howard before the American Institute of Mining Engineers at the February meeting, 1908, said:

"There is one very important point that I have not heard mentioned by Mr. Howard, and that is the question of the minimum amount of work. In the opinion of some of us there is too much work put upon steel at the present time and just as good results can be obtained by a lesser amount of work; in fact, maximum results may be obtained by a minimum amount of work on the material."

Planes of cleavage may be also developed by pressure in a material having no gas bubbles or other internal defects. The best illustration of this was given years ago by Professor Tindale in an article on the cleavage of roofing slates. He claimed that the planes of the cleavage in the slates were at right angles to the bedding and were caused by lateral pressure of the earth. To illustrate this he cast a cylinder of wax about 3 in. long and 3 in. in diameter and at the normal temperature compressed this cylinder to a cake about ⅜ in. thick. This was then cooled in a mixture of salt and ice and could be split like a piece of mica. In 1874 I repeated this experiment with similar results.

Many of us have known for years that there was a decided difference in the tensile strength and bending properties in transverse tests and longitudinal tests on pieces from universal steel plates; also that there was a much greater difference in similar test pieces cut from universal iron plates, but we did not appreciate the great difference in the strength and bending properties of the higher carbon rail steel as has been shown by Mr. Howard's paper to-night.

With this information before us it is not hard to account for rails with a shallow head failing by the side of the head breaking off in service in the plane of web, but it is the strongest plea for making a rail with a deep head and a good large fillet connecting the head to the web.

We are always going to have transverse weakness perceptible in steel rails and we should appreciate this in designing our rails and do the best we can with what we have to work with.

Preliminary Report of the Interstate Commerce Commission on Railroad Earnings.

"The preliminary report on the income and expenditures of operating railroads in the United States" for the year ended June 30, 1907, has been issued. It includes the results of operation of 894 operating companies, representing 225,584 miles, or approximately 99 per cent. of the mileage to be covered by the complete report.

There is given below the general summary of the earnings from operation and operating expenses of these companies for the year ended June 30, 1907, with comparisons for the eight preceding years:

Item.	Amount.	Proportion to total earnings.*	Per mile of line. 1907.[1]	1906.[2]	1905.[3]	1904.[4]	1903.[5]	1902.[6]	1901.[7]	1900.[8]	1899.[9]	Increase, 1907 over 1906.
Passenger service	$683,980,921	26.45	$3,032	$2,787	$2,647	$2,552	$2,492	$2,378	$2,194	$2,067	$1,928	$245
Freight service	1,826,209,111	70.62	8,095	7,403	6,710	6,519	6,539	6,056	5,741	5,466	4,895	692
Other earnings from operation	75,722,970	2.93	336	269	241	235	227	191	188	188	181	67
Unclassified earnings	.....	.....	...	1	...	...	...[10]	...[10]	...[10]	1	1	1[11]
Total gross earnings	$2,585,913,002	100.00	$11,463	$10,460	$9,598	$9,306	$9,258	$8,625	$8,123	$7,722	$7,005	$1,003
Less operating expenses	1,746,097,122	67.52	7,740	6,912	6,409	6,308	6,125	5,577	5,269	4,993	4,570	828
Income from operation	$839,815,880	32.48	$3,723	$3,548	$3,189	$2,998	$3,133	$3,048	$2,854	$2,729	$2,435	$175

[1] 225,584 miles of line represented.
[2] 222,340 " " " "
[3] 216,974 " " " "
[4] 212,243 miles of line represented.
[5] 205,314 " " " "
[6] 200,154 " " " "
[7] 195,562 miles of line represented.
[8] 192,556 " " " "
[9] 187,535 " " " "
[10] Less than $1.
[11] Decrease.
*Per cent.

Exhibits at the Maintenance of Way Convention.

Each year for the past three or four years it has seemed that any further addition to the number of exhibitors at the Maintenance of Way convention would compel some change which would involve seeking new quarters. And still the number continues to grow and in some way they are crowded into the parlor floor and adjacent hallways and rooms of the Auditorium Hotel.

The Road and Track Supply Association held its annual meeting on Wednesday, March 18, and elected the following officers: President, George Stanton, Sales Manager, Cleveland Frog & Crossing Co., Cleveland, Ohio; Vice-President, W. F. Schleiter, Secretary, Dilworth, Porter & Co., Pittsburgh, Pa.; Secretary and Treasurer, J. N. Reynolds, Vice-President, The Wilson Co., Chicago; Executive Committee, John C. McKinnon, Secretary and General Manager, Kalamazoo Railway Supply Co., Kalamazoo, Mich.; J. H. Martin, Hussey-Binns Shovel Co., Pittsburgh, Pa.; William Goldie, Sr., William Goldie, Jr., & Co., West Bay City, Mich.; T. W. Snow, President, Otto Gas Engine Works, Chicago; Robert E. Belknap, Chicago Agent Pennsylvania Steel Co. and Maryland Steel Co., Chicago; Theodore Huss, Secretary and Treasurer, Lufkin Rule Co., Saginaw, Mich.

Following is a list of the exhibits:

Adams & Westlake Co., Chicago.—Samples of "Adlake" signal lamps and long-time burners.

Adreon & Co., St. Louis, Mo.—Model of "Security" combination rail brace and tie plate; main rail brace and switch-point slide plate; "Security" guard rail brace.

Allith Manufacturing Co., Chicago.—Full-sized door, showing application and operation of Allith adjustable door hanger.

American Casting Co., Birmingham, Ala.—Samples of "National" short length, light weight, cast iron culvert pipe.

American Flange Frog & Railway Improvement Co., Roanoke, Va.—Model of Graham flange frog.

American Guard Rail Fastener Co., Philadelphia.—The "Anchor" guard rail clamp; tie-plate guard rail fastener; pressed steel rail braces.

American Hoist & Derrick Co., St. Paul.—Photographs of "American" railroad ditchers.

American Nut & Bolt Fastener Co., Pittsburgh.—Samples of Bartley nut and bolt fasteners.

American Railway Tie & Girder Co., Pittsburgh.—Model of Duff continuous longitudinal steel track structure.

American Steel & Wire Co., Chicago.—Samples of steel wire fence; concrete reinforcement; rail bonds.

American Valve & Meter Co., Cincinnati, Ohio.—"Economy" switch-stands, and model of track and switch showing operation of Anderson interlocking switchstand; Poage water columns and tank fixtures.

Asbestos Protected Metal Co., Canton, Mass.—Samples of asbestos protected metal for roofing and siding, and model of Robertson standard car roof.

Atlantic Equipment Co., New York.—Photographs of "Atlantic" steam

shovels and contractors' saddle-tank locomotives; steam and electric locomotives.

Atlas Railway Supply Co., Chicago.—"Atlas" rail joints, braces and tie plates, including the "Atlas" insulated and compromise joint; "Atlas" switchstand.

Automatic Nut Lock Co., Rockford, Ill.—Samples of nut locks.

Barker Mail Crane Co., Clinton, Iowa.—Full-sized Barker mail crane.

Barrett Manufacturing Co., New York.—Roofing and waterproofing materials.

Battery Supplies Co., Newark, N. J.—Samples of primary batteries.

Beaver Dam Malleable Iron Co., Beaver Dam, Wis.—Samples of malleable iron tie-plates and rail braces; also F. & N. anti-spreader and anti-creeper.

F. W. Bird & Son, East Walpole, Mass.—"Paroid" roofing, "Hydrex" waterproofing and "Neponset" insulating paper.

Louis Blessing and Alfred Johns, Jackson, Mich.—Model of concrete tie; also adjustable nut locks.

S. F. Bowser & Co., Ft. Wayne, Ind.—Models of Bowser self-measuring oil storage tanks and pumps.

Jos. M. Brown, Chicago.—Samples of Stone lanterns; also photographs of Buckeye light.

Browning Engineering Co., Cleveland, Ohio.—Photographs of Browning locomotive cranes, railroad ditchers and revolving steam shovels.

Bryant Zinc Co., Chicago.—Samples of crossing bells, batteries, relays, etc.

Buda Foundry & Manufacturing Co., Chicago.—Paulus, Buda and Wilson track drills, switchstands, rail benders, car replacers, ratchet and friction jacks, hand cars, velocipedes and gasolene cars.

Cambria Steel Co., Johnstown, Pa.—Sample "100 per cent." rail joint and "100 per cent." insulated rail joint.

Philip Carey Manufacturing Co., Cincinnati, Ohio.—Samples of Carey cement roofing and magnesia pipe coverings.

Carnegie Steel Co., Pittsburgh, Pa.—Duquesne splice bar; steel cross tie; also samples of built-up steel tie after six years and ten months' service in main track of Lake Shore & Michigan Southern Railway; U. S. steel sheet piling; Friestedt steel piling; steel mine timbers and screw spikes.

Central Iron & Steel Co., Harrisburg, Pa.—Samples of "American" steel cross tie.

Chicago Portland Cement Co., Chicago.—Literature describing Chicago Portland cement.

Chicago Steel Tape Co., Chicago.—Measuring tapes and jointed leveling rods; "Eureka" tape splice.

Cook's Standard Tool Co., Kalamazoo, Mich.—Cook's collapsible rail drill and drill grinders; standard track jacks and Cook's combination steel and wood cattle guard.

Cortright Metal Roofing Co., Philadelphia.—Samples of metal roofing and model showing application.

Credelbaugh & Carter, Radnor, Ohio.—Concrete fence posts and molds.

Detroit Graphite Co., Detroit, Mich.—Samples of graphite paints.

Paul Dickinson, Inc., Chicago.—Dickinson smoke-jacks; models of Dickinson cast-iron chimneys and ventilators; composite wood and cast-iron fireproof smoke-jacks.

Dilworth, Porter & Co., Pittsburg, Pa.—Goldie claw tieplates, Glendon flange tieplates and railroad spikes.

H. B. Dodge & Co., Chicago, representing Jas. G. Wilson Manufacturing Co., New York.—Models of swing and rolling doors.

G. Drouvé Co., Bridgeport, Conn.—Sample of "Anti-Pluvious" skylights; photographs of "Anti-Pluvious" skylights installed on Lackawanna station, Hoboken, N. J.

Duplex Metals Co., New York.—Sample showing "Monnet" process of welding steel and copper.

Eastern Granite Roofing Co., New York.—Samples of perfected granite roofing and sand-surfaced roofing.

Economy Separable Switch Point Co., Louisville, Ky.—Model of "Economy" separable switch points and "Odenkirk" switch stands; "Clary" tie plate.

Electric Storage Battery Co., Philadelphia, Pa.—Samples of "Chloride" accumulations and "Exide" batteries for car lighting and signals.

Expanded Metal & Corrugated Bar Co., St. Louis, Mo.—Transparencies showing examples of concrete reinforcement with Johnson corrugated steel bars in bridge abutments, culverts, elevators, storage tanks, retaining walls; also model of reinforced concrete trestle having both deck and piles made of concrete.

Eyeglass Tool Co., Newark, N. J.—Eyeless picks and track tools.

Fairbanks, Morse & Co., Chicago.—Full-sized No. 2-J inspection car; Barrett track jacks, rail drills, standpipes, wheels, etc.

Federal Cement Tile Co., Chicago.—Samples of "Indestructible" roofing.

Flexible Compound Co., Philadelphia, Pa.—Samples showing the application of "Flexible" waterproof compound.

Franklin Manufacturing Co., Franklin, Pa.—Samples of asbestos shingles, lumber and smoke-jack materials; model of "Century" asbestos smoke-jack for roundhouses (Gutelius patent).

Gartland Manufacturing Co., Marion, Ind.—Samples of picks.

General Fireproofing Co., Youngstown, Ohio.—Samples of cold-twisted lug bars for concrete reinforcing, expanded metal lath and diamond mesh fabrics and pin-connected frames for concrete girders and beam reinforcement; also "Trussit" metal for reinforcing light concrete roofs.

Gibraltar Manufacturing Co., Chicago.—Model of new structural steel "Gibraltar" bumping post, and "Gibraltar" mail crane.

Glazier Nozzle & Manufacturing Co., Indianapolis, Ind.—Model of "Glazier" universal nozzle.

William Goldie, Jr., Co., West Bay City, Mich.—Tie plugs.

Gordon Battery Co., New York.—Samples of Gordon primary cells.

Grip Nut Co., Chicago.—"Grip" nuts in various sizes.

Harrington Railway Safety Switch Device Co., Colorado Springs, Colo.—Working model of "Harrington" safety switch.

Hart Steel Co., Elyria, Ohio.—Samples of McKee flange and shoulder plates; also pressed point spikes.

Hayes Track Appliance Co., Geneva, N. Y.—Samples of "Hayes" lifting and pivot derails.

Hurley Track Laying Machine Co., Chicago.—Photographs, drawings and literature of the "Hurley" track-laying machine.

Hurst Automatic Switch & Signal Co., Rawlins, Wyo.—Working model of "Hurst" automatic switch.

Hussey-Binns Shovel Co., Pittsburgh.—Samples of shovels, spades and scoops.

Ideal Concrete Machinery Co., South Bend, Ind.—Model of concrete building block machine.

Illinois Malleable Iron Co., Chicago.—Small model of the "Bruyn" automatic swinging smoke-jack.

Kalamazoo Railway Supply Co., Kalamazoo, Mich.—Hand cars, velocipedes, track drills, track jacks, gages and levels; wheel with reinforced tread; Root scraper and flanger; Moore chuck; pressed steel wheels.

Kennicott Water Softener Co., Chicago.—Photographs of water softening plants, steel storage tanks and towers.

Edwin R. Kent & Co., Chicago.—Photographs and models of Allen's "Imperial" manganese steel frogs and crossings.

Keuffel & Esser Co., New York.—Samples of steel tapes, transits, surveying and measuring instruments, reckoning machines and special "Wisconsin" transit.

Kinnear Manufacturing Co., Columbus, Ohio.—Model of Kinnear rolling door, roundhouse type.

Lackawanna Steel Co., New York.—Abbott track gage plate, Abbott track gage and tie plate, Abbott rail joint plate, Abbott reinforced rail and Abbott composite rail tie.

Lehon Co., Chicago.—Samples of "Roofrite" roofing.

Locomotive Appliance Co., Chicago.—"Smyth" cast steel and "Freeland" clamp derailer for main line and side track; "Newton" wrecking frogs.

Lufkin Rule Co., Saginaw, Mich.—Metallic and linen tapes, steel rules, etc.

Mann-McCann Co., Chicago.—Model of railway spreader and grader; Mann smoke-jacks; Ravelin system of electric wiring for roundhouses; Chicago ventilator.

McClintock Manufacturing Co., St. Paul, Minn.—Samples in operation of McClintock mercury contact relay; full-sized electric automatic signal; switch indicators; circuit breakers; testing sets for relays.

Metal Ties Co., New York.—Full-sized cast steel tie with wood block for rail support.

Mississippi Wire Glass Co., New York and Chicago.—Samples of ribbed, mazed and plain wire glass.

Morden Frog & Crossing Co., Chicago.—Model of track and switch showing "Unity" switchstand.

National Lock Washer Co., Newark, N. J.—Samples of "National" lock washers.

National Railway Materials Co., New York.—Samples of Murray anti-rail creepers, guard-rail braces and clamps, rail braces, etc.

National Roofing Co., Tonawanda, N. Y.—Samples of "Security" mineral asphalt roofing.

Newman Clock Co., Chicago.—Samples of Newman watchman's clocks; also railroad special clock for yards, depots, docks, etc.

Robert Ogle, Pueblo, Col.—Model of Ogle turntable derailer.

Otto Gas Engine Co., Philadelphia and Chicago.—Photographs of coaling stations, water tanks and cranes, sand blast and pneumatic tool car.

The Pennsylvania Steel Co., Philadelphia, Pa.—Models of "New Century" adjustable switchstand with double crank; Manard anvil-faced frog; photographs of steel bridges.

Pepple Metallic Railway Tie Co., Hillsboro, Tex.—Metal tie and safety mail catcher.

Percival Wood Preserving Co., Houston, Tex.—Samples of timber treated with "Diamond" preservative by the open-vat method.

Phillips Signal & Electric Co., Owensboro, Ky.—Blueprints, printed matter, etc., regarding Phillips automatic crossing, block and bridge signals.

The Frederick Post Co., Chicago and New York.—Samples of surveying instruments, drawing materials, etc.

D. & A. Post Mold Co., Three Rivers, Mich.—Full-sized machines for making concrete fence posts (shaking device method).

Quincy, Manchester, Sargent Co., Chicago and New York.—Bonzano rail joint; Q & C insulated joint and compromise joint; Q & C-Sampson rail bender; anti-rail creepers.

The Rail Joint Co., New York.—"Continuous" insulated rail joint; standard "Continuous," Wolhaupter and Weber joints; insulated rail joints and step joints.

Railroad Supply Co., Chicago.—Samples of Wolhaupter, Q. & W. and Servis tie plates; R. R. S. derailer; Wolhaupter shoulder flange tie plate; signal materials.

Railway Chemical Sprayer Co., Owensboro, Ky.—Photographs of chemical weed killing car.

Railway Specialty & Supply Co., Chicago.—Smith improved lock nut; P. & M. rail anchor; "Kopp" signal glass; bond wire protectors; arc damp lightning arrester; "Paine's" vise-grip rail anchor.

Raymond Concrete Pile Co., Chicago.—Small model illustrating Raymond method of placing concrete piles.

Railway Equipment & Contractors' Supply Co., Chicago.—Literature describing the "Giant" rail bender.

Arthur E. Rendle, New York.—"Paradigm" fireproof windows and skylights.

Ritter Folding Door Co., Cincinnati, Ohio.—The Ritter horizontal folding door for roundhouses, freight houses and warehouses.

Roberts & Schaefer Co., Chicago.—Photographs of railroad coaling stations, coal washeries and tipples.

Safety Switch & Semaphore Co., Battle Creek, Mich.—Switchstand operated by a semaphore for single-track use on main line for facing point switch.

Sandusky Portland Cement Co., Sandusky, Ohio.—Samples of Medusa waterproof compound, and snow white Portland cement.

Scherzer Rolling Lift Bridge Co., Chicago.—Album and miscellaneous photographs of Scherzer rolling lift bridges.

Scott Manufacturing Co., Racine, Wis.—Model of "Hercules" bumping post.

Sellers Manufacturing Co., Chicago.—Samples of Sellers anchor-bottom tie plates and splice bars.

Spencer Otis Co., Chicago.—Samples of "Economy" tie plates.

Standard Asphalt & Rubber Co., Chicago.—Samples of waterproof bridge coatings and mastic floors; also pipe dips and insulating materials; "Sarco" asphalt filler for brick paving; concrete and brick reservoir lining; new moisture and damp proofing for buildings.

Arthur L. Stanford, Chicago.—Model of Stanford rail joint; sample "American" track jack.

Strauss Bascule & Concrete Bridge Co., Chicago.—Working model of the Strauss trunnion bascule bridge; model of ribbed reinforced concrete bridge.

E. S. Thomas, Fairfield, Iowa.—Sample of the "Endless" rail, a new form of rail joint.

Tool and Railway Specialty Manufacturing Co., Atchison, Kans.—Leaflets illustrating the "Au-tra-kar" spike screwing machine.

U. S. Metal & Manufacturing Co., Chicago and New York.—Samples of "Columbia" lock nuts; full-sized "Hilman" whistling post.

U. S. Wind Engine & Pump Co., Batavia, Ill.—Switchstands and semaphores; literature describing the new U. S. adjustable water columns; water tanks; model of "Mansfield" water column.

Universal Portland Cement Co., Chicago.—Samples of raw material in various stages of manufacture.

Variety Manufacturing Co., Chicago.—The Cross horizontal folding door, and "Variety" steel rolling door; Cross compound lift-up door.

Verona Tool Works, Pittsburg, Pa.—Track tool.

Vulcan Iron Works Co., Toledo, Ohio.—Photographs of Vulcan steam shovels.

C. H. Whall & Co., Boston, Mass.—Samples of Whall special railroad insulating fibre.

Wm. Wharton, Jr., & Co., Inc., Philadelphia, Pa.—Photographs and models of Wharton manganese-steel frogs, crossings, switches, etc.; Wharton guard rail clamp.

Whiting Foundry & Equipment Co., Harvey, Ill.—Photographs of electric traveling cranes, transfer tables, turntables, roundhouse cranes and equipment.

Williams, White & Co., Moline, Ill.—Blueprints of new automatic bucket holst coaling station.

Jas. G. Wilson Manufacturing Co., New York.—Full-sized sample of sliding swing door; also samples of rolling doors.

M. F. Wood, New York.—Harrington safety switch device.

Julian L. Yale & Co., Chicago.—Samples of "Universal" cast-iron pipe.

The Metal Tie.*

BY DR. ING. A. HAARMANN.
Geheimer Kommerzienrath.

II.

Permanent way with metal ties is no longer a novelty. In the last 40 years it has had a checkered career. The first attempts at using metal for supporting the rails date back still further. We will only refer to them here for the sake of completeness.

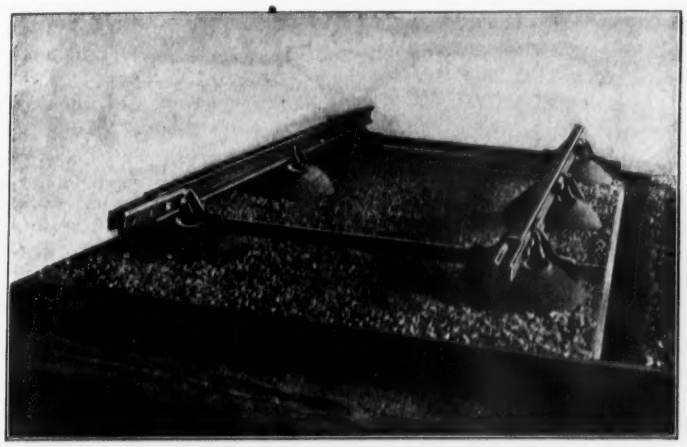


Fig. 21—Greaves Cast Iron Pot Ties; Alexandria-Cairo Line, 1854-1887.

During the period in which skill in rolling metal had not advanced to the point that enabled the rolling mill to put into proper shapes the tougher puddle iron, the Bessemer and open hearth steels, cast-iron attained some prominence as a tie material for railroads, especially in tropical countries where wood does not resist the climate and is attacked by white ants. Cast-iron pots (Fig. 21) were in use on the railroad between Alexandria and Cairo in 1854, and it was many years before they were replaced by creosoted wooden ties and by metal ties. The piece of track pictured was in service 20 years, using double-headed chair rails. The life of the tie is, however, greater than this. This system was abandoned, not because iron was used, but because of the difficulties of maintenance due to its construction. Flat cast-iron ties with a rectangular base were extensively introduced in East India in connection with flange rails fastened to jaws on the ties by means of wedges (Fig. 22).

For us, in Central Europe, the cross tie is the only one that is of moment in connection with a metal permanent way. It is interesting to note that the first trials, made over 40 years ago, scored a remarkably long life for the metal tie (Fig. 23). They were the "Cosyns" ties made of I-beams laid on their sides in the main track between Deventer and Zwolle in 1865, and, in part, are still in the track, having outlasted the rails several times over. Originally they were provided with wooden saddles (Fig. 24), which were later replaced by metal saddles. The small dimensions of these last furnished insufficient bearing surface, which was bad for the ties and caused distortions and fractures. Those of the ties which are still serviceable have been equipped anew with wooden saddles but of much larger dimensions. The deep bedding in the ballast, the firm position of the saddles between the flanges and the good bracing are acknowledged advantages of these ties, but they are lacking in stiffness and are too narrow, being only 8 in. wide. Each tie is 8 ft. 3 in. long, giving it 792 sq. in. bearing on the ballast.

After such a beginning, the introduction of the metal tie might have progressed more rapidly than was the case had not erroneous conceptions delayed its development. Metal permanent way was to cost no more than that with wooden ties. Low in cost, indeed, but much too weak, too light and therefore really too dear were the characteristics of the metal ties prominent at the end of the sixties in Germany. To this class belongs the Vautherin tie, laid in the line between Wittenberg and Leipsic, at first with rails resting directly on the ties, but afterwards, when wear had begun, supported on plates riveted to the ties (Fig. 25). Still, these small ties with their little clips stood the service for 17 years, from 1870 to 1887, of course not without suffering severely from wear, distortion, breaks and splitting (Fig. 26). I do not intend to pass in review the large number of different ties and methods of attachment that were tried more or less extensively or that were proposed as improvements. I will only bring forward the most important of these various designs (Figs. 27 and 28). Merely glancing at this selection of widely used ties, it is evident that railroad men and rolling mill men were too long under the impression that they could get along with a minimum quantity of metal, a mistaken notion not entirely overcome at the present time. The shape, indeed, was extensively varied, the lower edges were made thicker or thinner or were given a vertical or again a horizontal direction, but the original weight of about 65 lbs. was only slowly increased until a weight of 165 lbs. was reached, accompanied by a lengthening of the tie from 7 ft. 3 in. to 8 ft. 10 in.

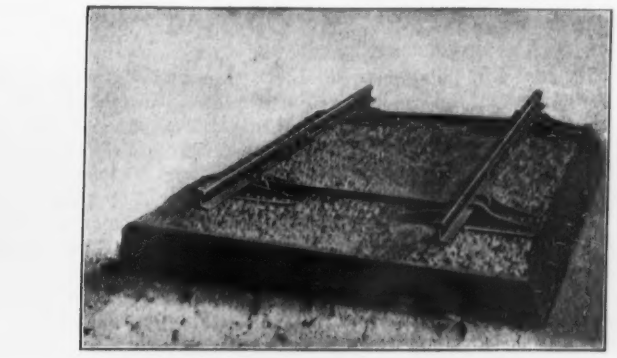


Fig. 22—Denham-Olpherts' Cast Iron Plate Ties; Rajputana-Malwa Line, Narrow Gage.

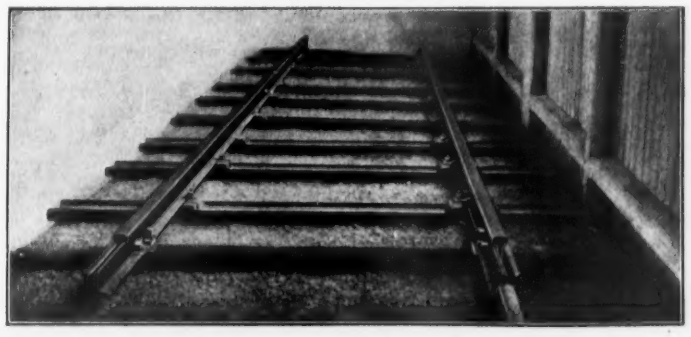


Fig. 23—Cosyns Ties with Saddles; Deventer-Zwolle Line, 1865-1907.

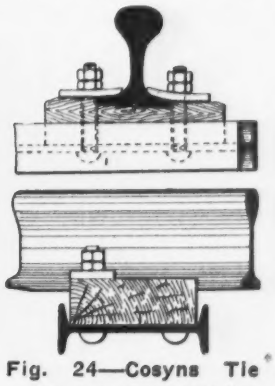


Fig. 24—Cosyns Tie with Wooden Saddle.

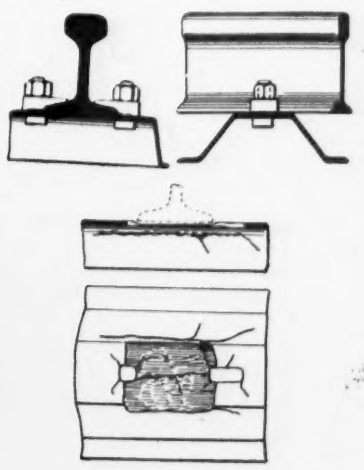


Fig. 26—Wear of Metal Tie Under Rail Seat; Wittenberge-Leipsic Line, 1870-1887.

The metal cross-ties developed from Hilf's longitudinal tie and from its variants were in part equipped with wedge fastenings, in part with clips and screws. A permanent way of this kind was in operation from 1889 to 1892 between Hagen and Haspe, on the old Bergisch-Märkische

*Address delivered at the meeting of the "Verein der deutschen Eisenhüttenleute," Dec. 8, 1907, at Düsseldorf. Reprinted from *Stahl und Eisen*, by permission.

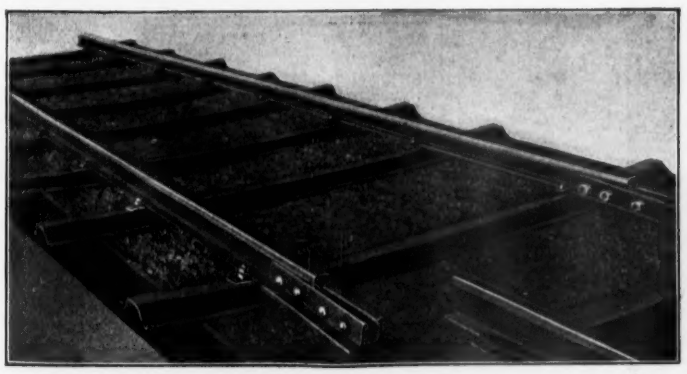


Fig. 25—Vautherin Ties with Clips; Wittenberge-Leipsic Line, 1870-1887.

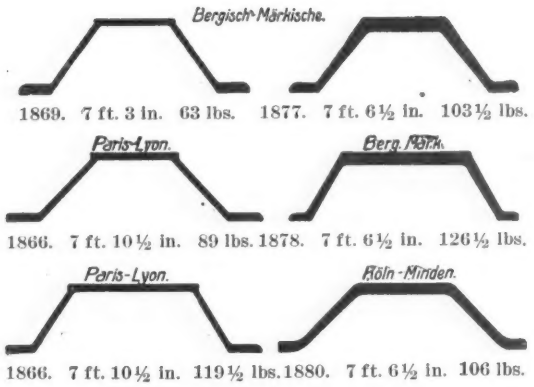

Bergisch-Märkische.
1869. 7 ft. 3 in. 63 lbs.
1877. 7 ft. 6½ in. 103½ lbs.
Paris-Lyon.
Berg. Märk.
1866. 7 ft. 10½ in. 89 lbs.
1878. 7 ft. 6½ in. 126½ lbs.
Paris-Lyon.
Köln-Minden.
1866. 7 ft. 10½ in. 119½ lbs.
1880. 7 ft. 6½ in. 106 lbs.

Fig. 27—Older Tie Sections.

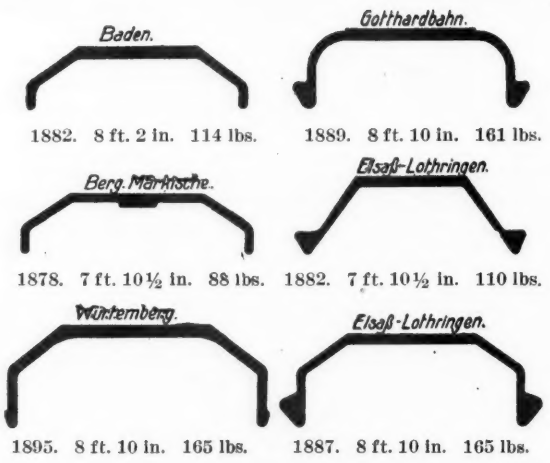

Baden.
1882. 8 ft. 2 in. 114 lbs.
Gotthardbahn.
1889. 8 ft. 10 in. 161 lbs.
Berg. Märkische.
1878. 7 ft. 10½ in. 88 lbs.
Elsaß-Lothringen.
1882. 7 ft. 10½ in. 110 lbs.
Württemberg.
1895. 8 ft. 10 in. 165 lbs.
Elsaß-Lothringen.
1887. 8 ft. 10 in. 165 lbs.

Fig. 28—Newer Tie Sections.

Railroad (Fig. 29). The small bearing surfaces occasioned excessive wear. As wedge fastenings did not get a firm hold, those by means of clips were developed and have come into general use.

The permanent way of 1896 of the St. Gotthard Railroad will serve as an example of the newest construction, in which the inclination of the rail is still obtained by bending the tie, while the gage is regulated by the use of different sizes of clips (Fig. 30). Inspection shows plainly that the rails and clips in the course of five years' service have begun to wear into the ½-in. upper surface of the ties.

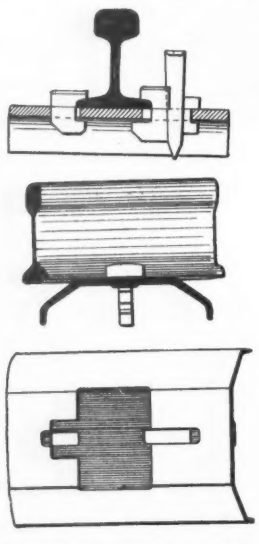


Fig. 29—Wedge Fastening, and Wear of Tie; Hagen-Haspe Line, 1889-1892.

In the Carnegie tie, used experimentally in the United States during the last few years, clip fastenings have also been employed, the rails resting directly on the ties (Fig. 31). But the clips are not utilized to relieve the side pressure on the bolts by dropping them into slots (Fig. 32). As the American rails are not inclined, but are placed vertically, bending the ties was not necessary. I have examined several stretches of track equipped with Carnegie ties, and am confirmed in my opinion, expressed in the *Railroad Gazette*,* that the derailment of February, 1907, at Mineral Point, which was accompanied by a shearing of the outer bolts, was not to be ascribed to the use of metal, as such, but to the defects indicated. Moreover, it seemed to me that the track with Carnegie ties rode smoothly but somewhat hard. This may be due to the narrow supporting surface, 8 in., and to the too great stiffness of the tie. To be sure, the stiffness is of advantage for static reasons, as it results in a well distributed, but in this case unnecessarily high, pressure on the ballast. The Carnegie tie (several samples taken from track have been kindly furnished me by the Carnegie Steel Co.) weighs 167 lbs., with a supporting area of only 705 sq. in. Structural improvements are under way, but it seems to me a mistake that, in introducing the steel tie in the United States so little use should have been made of the experience that has been gathered in Germany during the last 35 years.

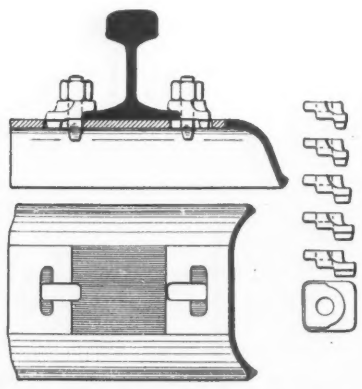


Fig. 30—Clips Recessed in Tie; Gotthard Railroad, 1896.

The Prussian railroads have, at different times, recognized as standard four different tie sections (Fig. 33). The first, introduced in 1881, was the box cross tie modeled after my abandoned longitudinal tie. Its form, however, proved ill adapted for the distribution of pressure, the horizontal flanges tending to curve upward, while the central space could not be solidly tamped. The next two sections, forms 51 and 52, appeared at about the same time, in the middle of the eighties. Form 51, 8 ft. 10 in. long and weighing 128 lbs., with 970 sq. in. bearing area, has enjoyed a preference up to the present day as a standard shape for main line. The fourth and wider section, form 50, originally designed for switches, weighs 167 lbs. and has a bearing area of 1,172 sq. in. In recent years it is coming into use for joint ties and in some cases for intermediate ties.

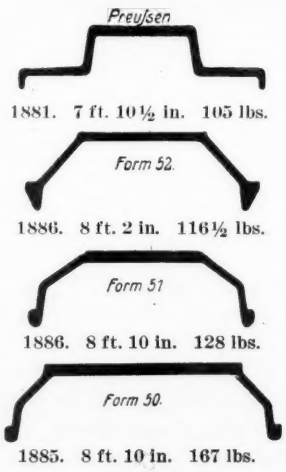


Fig. 33—Standard Tie Sections; Prussian State Railroads.

(To be continued.)

**Railroad Gazette*, Sept. 27, 1907, p. 352.

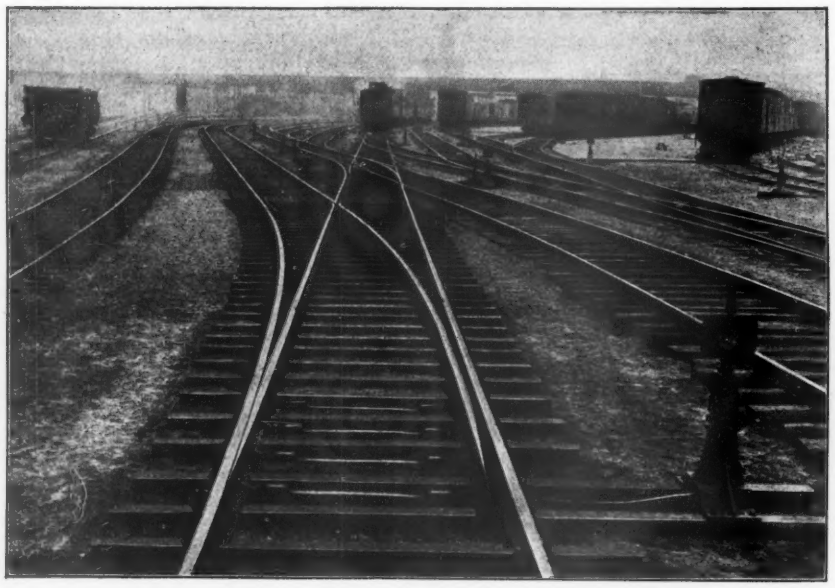


Fig. 31—Carnegie Ties, 1906.

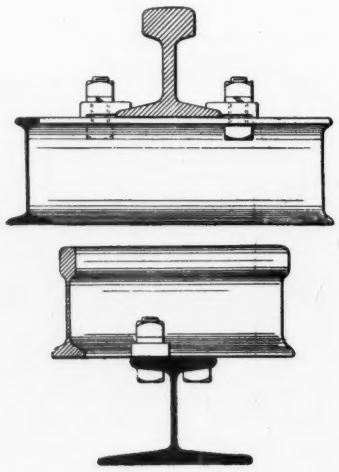


Fig. 32—Carnegie Tie, 1906; Clips Not Recessed in Tie.

The Ocean Carrier.

BY J. RUSSELL SMITH, PH.D.

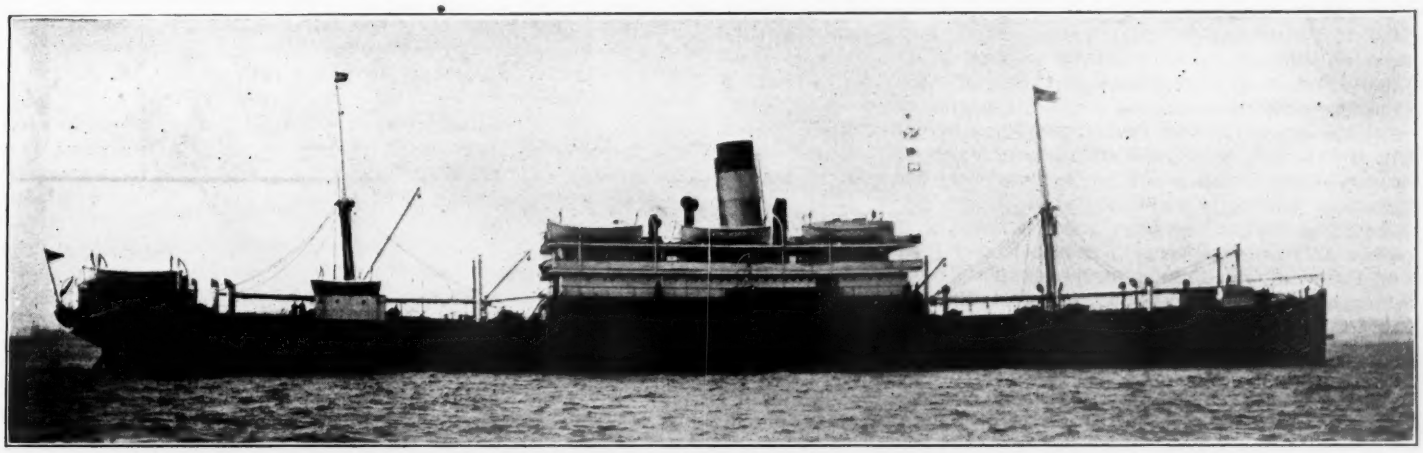
XII.

The Leading Routes of Ocean Commerce.

Of vessel tracks upon the world ocean there is an innumerable and increasing multitude. Any one of several hundred ports may from time to time be visited by a vessel from any other of these ports. This movement over a certain track may be isolate, occasional or regular. Even the regular trade routes amount to hundreds, passing in all directions across all oceans between the frigid zones, and some routes invade even a portion of the Arctic ocean.

The routes of the ocean, like those of the land, consist of trunk lines and branches or feeders, which, leaving the main ocean thoroughfares, reach out to the islands or to the ports of the more isolated arms, gulfs and bays that indent the continents. These trunk routes comprise the real circulatory system through which passes the greater part of the commerce of all nations. The advantage of location possessed by the trunk routes causes them to draw to themselves through their feeders the great majority of vessels traversing the ocean.

The number of ocean routes has been more than doubled during the latter half of the nineteenth century by the use of the steamer. This newer type of vessel rarely followed the older route that had sufficed when wind and sail were the sole dependence of the navigator. The sailing vessel must depend upon winds, weather, currents and tides, and in order to take advantage of these factors it is often necessary to make detours to catch favorable conditions or to avoid the danger of being blown upon the shore. The steamer, with greater power of guidance and always desiring to save time and fuel, goes as nearly as possible in straight lines. Hence the two types of vessels rarely follow the same track, and there are, for a large part of the world's oceans, two distinct sets of routes: those followed by steamers and those followed by sailers.



Steamship Verdi; Lamport & Holt Line to Brazil and the River Plate.

The location of sailing routes differs from that of steamer routes because of the different methods of navigation. With the steamer every mile covered costs a certain coal consumption, so that the steamer routes, reckoned in miles, are almost always the most direct routes possible, deviations only being made to avoid rocks, ice, thick fog or very stormy locations. The steam navigator thinks of his voyage in miles because distance is the chief factor, but the sailing captain reckons his voyage by days because the varying winds may take his ship one mile or 200 miles in a day; or again, headwinds may make it necessary to "tack," or sail from side to side, so that 200 miles of sailing means but 100 miles of progress. Thus it comes about that sailing routes are decided not by the shortest lines, but by wind and other conditions over the seas traversed.

The force and regularity of the wind differ greatly in different parts of the ocean, and to avoid regions of calm or low winds or head winds, the sailing routes often make wide detours in mid-ocean, and owing to the peculiarities of a sailing ship these vessels rarely go to and fro between two given points by the same route, because the wind that speeds the departing retards the returning vessel. Further than this, the winds in many parts of the world change with the seasons, and the sailing routes of winter are different from those of summer. Owing to the lessened certainty of location and lack of freedom along coasts, sailing routes do not lend themselves so easily as steamer routes to the development in trunk routes and branches. Where such classification is possible it is decided more by wind influence than by common destination.

In this article there will be no attempt to describe or enumerate all the routes. For an economic discussion many routes which, from the standpoint of the navigator, are separate, may be grouped under one heading and treated as a unit, as in commercial service they really are.

Western Europe and eastern North America are the greatest manufacturing centers for the rest of the world, and are consequently the starting point or the ending point for the leading ocean routes because the great basis of international trade is the exchange between the regions producing manufactures and those producing raw materials and food. Since the leading commercial countries of Europe are on, or adjacent to, the English channel, that body of water may, in a partly figurative but almost literal sense, be considered as the origin of European routes and similarly New York bay of the American routes.

As North America is also the greatest exporter of food and of raw materials to Europe, the most important of the ocean trunk routes connects eastern North America with northwestern Europe. On this great thoroughfare is regularly employed more than a sixth of the world's ocean shipping, including the largest and fastest ships afloat.

For convenience we will call this the North Atlantic trunk route. It is not strictly accurate to call this a route, for it is a complex group of routes crossing and paralleling each other and converging to several foci, but they are surprisingly close together in mid-ocean. The Liverpool Steamship Owners' Association declared in an address to the British Board of Trade "that all vessels crossing the Atlantic to this country (Great Britain) from ports in North America take practically the same route from 60 W. longitude." This comes about because of the advantage of following the great circle route, which, curving to the northward, makes all vessels, whether from Halifax, New Orleans or Vera Cruz, follow close to the northeastward-trending coast of North America to the Grand Banks off Newfoundland before starting to cross the ocean. During the spring and summer months a somewhat more southerly track is followed, owing to the floating ice, and for this reason the St. Lawrence steamers are compelled to pass to the south of Newfoundland. During the ice-free part of the year, from September to April, the compact sheaf of routes is somewhat scattered, and for a short time St. Lawrence steamers pass to the north of Newfoundland with a considerable saving in distance.

These northern or great circle routes are so much shorter than the direct following of the parallels of latitude, that the route from Liverpool direct to Greytown, Nicaragua, is only 323 miles, one day's moderate steaming, shorter than the route by way of New York. Norfolk is a common coaling port for vessels passing from the Gulf of Mexico to Europe.

The sailing tracks for this route show how thoroughly this type of transport depends upon the whims of the air. It was found in the old packet days that the journey directly westward to New York was in time 50 per cent. longer than the journey eastward and that a long southern detour on the western voyages was sometimes a benefit from the point of time. The explanation of this as of all the other facts of sailing route location depends upon an understanding of the main fact of the world's wind circulation, which should therefore be briefly stated here.

The combined influence of the motion of the earth and the different temperatures in different latitudes produce a general wind system upon the surface of the earth and with greater regularity upon the oceans than upon land. This wind system is studied by the sailing captain as carefully as the coal question is by the owner of a line of steamers. The winds are most regular and reliable in the hot latitudes. The part of the Torrid Zone receiving the most direct rays of the sun gets hottest and is a region of calms because the highly heated air is rising. This rising air of the zone of calms is replaced by the air that blows in from north and south, the trade winds which sweep regularly over the torrid

zone and are deflected from north and south to northeast and southeast winds by the earth's rotation toward the east. In some regions, particularly off the coast of Spain, the trade winds extend to a considerable distance beyond the tropic, but this is unusual. Owing to the apparent northward and southward motion of the sun, the zones of the trade winds and doldrums also move several degrees north each summer and south each winter. In both the temperate zones the prevailing winds are westerly, though not so constant as the trade winds, being more liable to disturbance by cyclonic storms, during which for a day or two the wind blows from all points of the compass in turn.

The sailing routes of the Atlantic illustrate in a striking manner the effects of the prevailing winds. Between the northern states and the English channel the sailing vessel goes before the westerly wind and follows closely upon the steamer route. Returning there are two routes, a southern and a northern. The northern faces the west wind and involves much tacking back and forth. The southern route going southwest to avoid the westerly winds and get into the trades, passes along the coast of Spain, south of the Azores and Bermudas, and crossing in the latitude of Havana comes up northwestwardly to the middle Atlantic states. If the destination is the Gulf of Mexico, the recommended track is still farther south, passing into the Caribbean near Barbados and out through the Yucatan channel into the gulf. In the winter this southern route is made even longer because the vessel must go farther south to reach the trade winds. Even the vessel bound for New York may then go 150 to 200 miles south of the tropic of Cancer. At this season the seas east and northeast of Newfoundland are more favorable to ships because free from ice. The icebergs and ice floes are released from their frozen moorings by the summer thawing and float about the ocean during summer and autumn. The solid freezing of winter holds the next ice crop in place until the succeeding June. During this season vessels returning from North Europe are recommended to follow the northern route. From the North Sea they go around Scotland, those from the channel steer northwest from the Scilly Isles or southwestern Ireland, till latitude 54 deg. is reached, then from mid-ocean a southwesterly route is followed along the coasts of Newfoundland and Nova Scotia. This northern detour is taken to avoid the strong headwinds and storms which often rage during this season with great fury between 45 and 50 deg. north.

The route next in importance to the North Atlantic is the Mediterranean Asiatic trunk route, passing from the Straits of Gibraltar around the continent of Asia to Japan. This route, the great thoroughfare between the east and the west, has many feeders east of Gibraltar, and double termini in the Atlantic, one in the region of the English channel, one in America, chiefly New York, but partly also in the Gulf of Mexico. As it skirts the coast of Eurasia it is fed by a branch from every bay that indents that great land mass, and by other branches from Africa, the East Indies and Australasia. Important contributions come from Barcelona in Spain, Marseilles in France, Genoa and Naples in western Italy, Venice and Trieste on the Adriatic, Smyrna and Piraeus on the Aegean, Constantinople, Odessa and Batum on the Black Sea. At Alexandria the commerce of Egypt is received and at Aden a part of the trade of the Persian Gulf, East Africa and Bombay, the main line going on to Ceylon and Singapore. At Colombo vessels for Calcutta, Madras and Burmah turn northward into the Bay of Bengal and the Australian mail steamers turn southward across the Indian ocean; at Singapore the route, rounding the corner of Asia, sends a branch to Java and on to Torres Strait and east Australia, receives the traffic from Siam, Tonquin, the adjacent East Indian islands and some from Manila. The main route passes on to Hong Kong, Shanghai and Yokohama, Shanghai being the branching off point for the trade of Vladivostok, Port Arthur, Tien Tsin and other ports in North China and Korea, and latterly it is extended even to San Francisco, with more services promised for the Pacific coast of America.

This great route from the west to the east is the creation of the Suez Canal. Before the opening of that gateway of the seas it was entirely unprofitable for steamers to engage in the trade between the Orient and the Atlantic. The trade was then comparatively small, and the greater part of the present traffic is the creation of the new route, which is now as absolutely monopolized by them.

The rocks, reefs, narrow passages, calms and fitful winds of the Red Sea combine with towage and tolls at Suez and poor winds in the Mediterranean to absolutely block this route to sailing vessel traffic.

The Good Hope route is not such a coasting route, nor is it so well supplied with feeders. The peculiar shape of the west African coast, and the scattering character of its commerce, have brought about a duplication of steam routes in the Atlantic west of Africa. The coasting and local route follows the coast, settlement by settlement, from Morocco to German Angola. The more important route, the South African route, sweeps boldly around the continent to Cape Town with occasional stopping of ships at the Cape Verde islands for coal. At Cape Verde, or to the south of it, two branches of it unite to form the route, one connecting with the English channel, one with New York bay. East of the Cape of Good Hope the vessels in the African trade stop at the British South African ports of Port Elizabeth and East London, most of them continuing to Delagoa Bay, but rarely farther. A few pass up the east coast of Africa. African ports are, however, the destination of but a part, less than half, of the vessels traversing the South African trunk route. The others go directly to Australia and New Zealand, often without touching Cape Town. From the United States to Australia the Suez Canal route is practically as long as the Good Hope route, and all the vessels naturally follow the cheaper and more open route around the continent. From England the saving by canal is about a thousand miles, not enough to make its use profitable for any but fast passenger and mail ships. The purely freight lines from Europe use the South African trunk route. The more important lines steer directly from South Africa to Adelaide, Melbourne and Sydney, and sometimes go on to Brisbane. Less important ones run directly to Freemantle, West Australia, to New Zealand, or to New Zealand via Melbourne or Hobart (Tasmania).

The Good Hope route divides with the Cape Horn route the honors of being the heaviest factor in the world's sailing traffic. They are typical sailing tracks. The inbound and outbound tracks differ, and there are also the seasonal variations, but these sailing tracks are more deserving of the title of a trunk route than any others in the world. The equatorial section of the outbound route is followed by all vessels from both Europe and America destined to the coasts of five continents bordering upon the Pacific and Indian oceans. The inbound routes to Europe and America are not at any time united so completely, although they have some of their divisions in common.

The outgoing routes converge in the equatorial section because they cannot safely pass Cape St. Roque without going with the trade wind that blows from the Canaries directly toward the point of South America. European vessels have a direct route from the English channel until they reach the trade winds off the coast of Spain or Morocco, before which they easily ride.

The vessels from the Atlantic coast of the United States would be delayed by the trade wind if they sailed directly toward Brazil. The quicker way for them to reach Cape St. Roque is to go with the west wind eastwardly across the Atlantic toward the Azores, then turn south and go with the trade wind. This route joins the European near the equator. From this point southward to the tropic of Capricorn vessels bound for the Indian ocean proceed directly south to avoid the southeast trade and catch the prevailing west winds which carry them across the South Atlantic to Cape Town and into the Indian ocean.

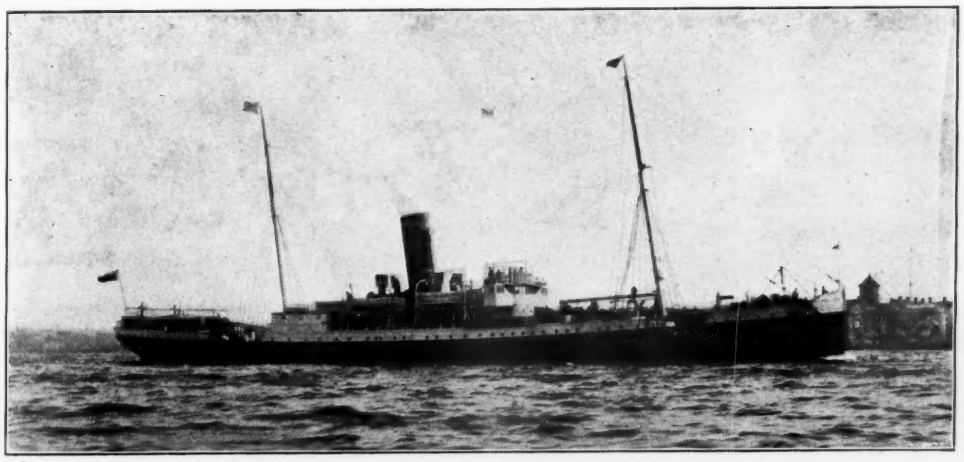
The inbound routes of the Atlantic are everywhere in different locations from the outbound. In returning from the Indian ocean the southern west winds are a hindrance and the navigator keeps as close to the Cape of Good Hope as possible, and sails northwest into the trade winds and on toward the equator. The American and European routes from the Indian ocean diverge from the Cape; the first named going almost directly to New York, thus crossing the northeast trade at a right angle, and having nearly the same angle to the Gulf Stream and the prevailing westerly winds north of Bermudas. The European routes in crossing the northeast trades are driven so far to the west that they enter the zone of westerly winds in the longitude of eastern Brazil and Greenland, and, passing to the west of the Azores, approach their destination from a westerly direction.

The Good Hope route gathers to itself almost the whole sail traffic of the Indian ocean. These routes have a distribution altogether different from that occurring in other oceans because the wind system of the northern half of the Indian ocean is unlike that of the other oceans, due to the disturbing influence of the continent of Asia. This enormous and largely arid land mass lies just to the north of the trade wind zone, and in summer it becomes so much hotter than the ocean to the south of it that the air rising from over the land draws toward the land an enormous southwest sea breeze blowing continuously from the equator toward Asia—directly reversing the trade wind during the summer months. These winds, bearing the name of monsoons, occupy the latitude of the northern trades, and by their force sweep across the greater part of the usual zone of calms, and in the season of the northern summer they exert some influence several degrees south of the equator. The southern part of the Indian ocean has a normal trade wind at all seasons and the northern part has in the winter months.

The sailing routes of the Indian ocean, the creation of these winds, unlike those of the Atlantic and Pacific, have somewhat the form of trunk lines and branches with separate systems inbound and outbound at the point of Africa. The inbound trunk follows the southern margin of the ocean from west to east. On this thoroughfare the navigator takes advantage of the steady west wind as long as possible before turning northward to the ports of Africa, Asia or the East Indies. Australian vessels complete the voyage before the west wind. Vessels turning toward Asia or the Sunda

Islands can sail by the trade winds directly north to the vicinity of the equator. Here the course, for points beyond the equator, must change to take advantage of the changing monsoons. The summer route to Bombay passes north close to the east coast of Madagascar, and goes with the southwest monsoon across the Arabian Sea. The winter route, avoiding the full force of the winter (northeast) monsoon, goes northward toward Ceylon and then turning northwest follows the west coast of India at right angles to the wind. The return routes for both seasons follow closely upon the latter route as far as the equator, and then, like all the returning routes of the Indian ocean, go west southwest across the southeast trade wind to the point of Africa, avoiding the westerly winds as much as possible. The routes to and from Calcutta show the results of exactly the same principles that entered into the location of the Bombay routes. They do not cover so wide an area because the Bay of Bengal is so much narrower than the Arabian Sea. Sunda Strait, the sailers' gateway to the East Indies, the Philippines and the coasts of East Asia, is below the monsoon zone, and has but one approach directly from the south and one outbound route, a direct line to the point of Africa.

The South American trunk route sweeps around the two longer sides of that continent from Cape St. Roque to Panama and on up the coast of America to British Columbia. Like the other trunk routes it is fed from two sources, Atlantic North America and Europe, the two parent streams uniting at Cape St. Roque. The greatest sources of traffic for this route in eastern South America are the Brazilian coffee from Rio Janeiro and Santos, and the grain and animal products of the La Plata ports. Many vessels, devoted only to the trade of the west coast, call at east coast ports only for coal, but discharge and receive cargo at many ports upon the west coast between Valdivia in southern Chile and Guayaquil, Ecuador. A few steamers continue this semi-coasting trade along the coasts



Steamship Obidense; Booth Line to Para.

of western Columbia, Central America, Mexico and the United States to San Francisco and Puget Sound. Other steamers round the continent of South America, but have no South American trade. Since 1901 a number of steamers have sailed from the Pacific ports of North America for European ports without doing a coasting trade en route, but all steamers in this trade are an innovation in a trade that has belonged exclusively to the sailer.

At the Straits of Magellan the traffic of this route is swelled by vessels in the New Zealand trade, particularly those returning loaded toward Europe. With this exception, the South American trunk does not in its steam traffic receive long branches or feeders as does the Mediterranean-Asiatic in rounding the continent of Asia. The difference is more apparent than real. The Asiatic route skirts the heads of peninsulas, and is often hundreds of miles from the ports lying at the heads of the seas indenting the coast. The branch routes to these ports are evident. The coast of South America is so even that any steamer passing around the continent passes comparatively near to all the ports. The real effect of branches is preserved by the division of the territory among the steamer lines. Some call at the ports of one section of the coast and have no freight connection whatever with other districts. Some lines of west coast of South America steamers are as separate from the other traffic of the South American trunk as the Calcutta or Zanzibar steamers are separate from the remaining traffic of the Mediterranean-Asiatic trunk.

The sailing contingent on the South American trunk route keep safely out of sight of the steamer that hugs the coast to save miles. While the steamer creeps through the squally and tortuous Straits of Magellan the sailer puts in another thousand miles in enduring the buffetings of the western fury off Cape Horn. So steady and so strong is this wind that ships sometimes stand for weeks in almost one place and some have given it up and turned about to seek their Pacific destination by going around the world before the west wind that ramps about without ceasing across the antipodean seas.

The sailing routes of the Pacific are shaped by the same forces that operate in the Atlantic. The effect of the prevailing winds is distinctly marked in the north and south tracks. Northward from Cape Horn vessels run comparatively close to the coast and directly across the course of the west winds. When the ships bound for the Pacific coast of the United States reach the southeast trade they follow it to the equator, work as best they can directly north across the zone of calms and then at right angles across the northeast trade until they reach the westerly winds, before which they run directly to the land. This last characteristic is much more pronounced in the route from Australia. The remarkable curves in the northern and southern parts of this route giving it the shape of a letter S, are striking evidences of the value to the sailor of the westerly winds of the temperate zones. The sailing route from San Francisco to Cape Horn goes southward with the northeast trade, turns to the west to get a sailing angle across the southeast trade and then below the tropic gradually swings southeastward to the Cape with the westerly winds. From San Francisco to Australia this route is comparatively direct to the tropic of Capricorn, where a turn to the west is made to avoid the westerly winds until as near the Australian coast as possible.

The captain sailing around Cape Horn into the Atlantic desires to avoid the coastal wind and current that carried this ship downward and inside the Falkland Islands. Inbound, he steers far to the east of the Falklands, keeping in the prevailing west winds as long as possible, and then borne onward by the southeast trades makes a gradual curve toward the equator at mid-ocean. If the destination is America, a northwesterly route is taken at 10 deg. S., and north of the equator, the routes to American and European ports are similar to those from the Indian ocean, described above.

The Pacific ocean is peculiar in that it may in a sense be said to be uncrossed by any present or prospective Great Routes except the one calling at Hawaii. Despite the riches upon its shares, the Pacific may well be called a waste of water. Only upon or near its margin will great and promising trade routes arise, leaving its vast center to silence and to routes of secondary importance. It is difficult to realize that this one ocean embraces nearly one-half of the entire surface of the globe, that between the mainland of the American continent at the equator, in Ecuador and the opposite mainland of Asia, near Singapore, lies the distance of 12,000 miles, or 175 deg., almost half the distance around the world. Between these two equatorial points upon the spherical surface of the globe there are three connecting lines of practically equal length, one following the equator directly across the mid-ocean and two slightly shorter ones following the meridians (great circles) and passing respectively near the north pole and the south pole. As steamer routes follow great circles, the great size of the Pacific causes most of its routes to avoid its middle and skirt its margin. Routes from east to west must, to follow great circles, keep in high latitudes near the margin of the ocean to secure their shortest courses. A glance at Pacific traffic shows it to be on the margins.

The heaviest commerce in the Pacific waters passes up and down the coasts of East Asia and of South America, bound for the exits at Singapore and the Straits of Magellan. By far the most important route entirely upon the Pacific is that connecting North America and Asia, the American-Oriental trunk route. Like the North Atlantic route this is a composite one, and not so compact because of the irregularities produced by the calls of some lines at Hawaii, 2,000 miles below the line of shortest passage between Puget Sound and Yokohama. It is nevertheless proper to consider the North Pacific lines as one trunk route, since all the different courses are close together at the American end, and converge at Yokohama to follow the Asiatic coast to the ports of China or the Philippines. One line now sends steamers to Manila directly from Yokohama, having them call at Hong Kong and Shanghai on the return. It is probable that other lines now sailing no farther than Hong Kong will, if there is increase in Philippine industry, extend their service by making Manila the final destination. This fact of the shape of the earth and the great circle routes show the futility of the hope that Manila might become the Gateway of the East. It is the last port of the row.

On the American side the Asiatic lines have within recent years originated at six places: Manzanillo (Mexico), San Diego, San Francisco, Portland and Puget Sound, and before many years there will probably be other American ports added to the list, although the first two are now discontinued. Lines of vessels start from San

Francisco and call at Honolulu, although it lengthens the voyage more than 800 miles. From all starting points vessels also go directly to Yokohama, and usually by the northern or great circle route. From Puget Sound it is impossible to follow a perfect circle because of the Aleutian Islands, within sight of which the vessels pass in good summer weather. In the winter it is the practice of some captains to steer straight across the ocean or even to go south of the direct route to secure more favorable winds and weather. The great circle route is the one most commonly followed, unless calling at Hawaii, and from all points on the American coast, including Panama, this, the mathematically shortest route to any point in Asia, follows the coast line to California, passes close to San Francisco, closer to Puget Sound than to Hawaii, and thence northward to the latitude of Alaska before turning south and skirting the shore of Japan.

A route of less importance and far less promise than the Oriental is the Pacific coast, Australasian, the last of the steam trunk routes. This route, like the preceding, is composite and more definitely spread out than any other trunk routes. On the east is the course followed by the line plying between San Francisco and Auckland, New Zealand, via Tahiti, Society Islands; on the west that from Vancouver to Sydney via Honolulu and Fiji Islands. By a branching of the route at Honolulu, San Francisco is connected with Sydney, and by other branchings at Fiji and Samoa, British Columbia is connected with New Zealand.

This route across the Pacific has been found by experience to be the quickest mail route from Australia to Europe. The weather in the Pacific is usually reliable and favorable, and when the mail has reached San Francisco by direct steamer, it has the advantage of the fastest long-distance train service in the world to New York, and thence to Liverpool the fastest steamship service in the world. In competition with this is the route followed by the slower steamers crossing the Indian ocean, the Red and Mediterranean Seas, and delivering the mail to the railroad only at Brindisi, Italy, whence, with several days saving of time, it crosses the Alps to Paris and London. There are fundamental traffic reasons, however, why the Pacific coast-Australasia routes lack great promise for the future.

The winds of the North Pacific being essentially like those of the North Atlantic produce a very similar result in sailing tracks, except that all vessels follow the southern track going west.

This brief presentation of the world's ocean routes makes no pretence of being full or complete, but only to point out the main arteries of world commerce, leaving the minor tributaries and distributaries to be worked out by those who may have a special interest in the subject.

The avenues of commerce have been divided off into routes having separate names, but it should not be thought that each is separate from the others. The divisions have been made in part for convenience of description, for the routes are not entirely separate, but connect and overlap at various points into a unified system encircling of the world.

No trunk route with its branches can be considered as an independent unit of circulation with vessels limited to it, and going and coming in even procession with equal numbers inbound and outbound. As no country imports and exports equal quantities of freight, so no route has similar amounts of freight or the requirement for equal number of vessels going and returning. It is usually but not always true that the line steamers go and return by the same route. The irregular element is chiefly furnished by the chartered vessels or tramps which depart from the trunk routes at ports where more freight is imported than exported. They go seeking freight and join other routes at ports that ship more freight than they receive. By this process the Good Hope route is a heavy loser, and the South American and the Mediterranean-Asiatic are gainers. South Africa imports coal, flour, lumber and general manufactures and supplies—all of them being heavy and bulky articles. The leading exports are gold and diamonds, requiring no space worth mentioning. South Africa is, therefore, a dispersing for vessels charged with ballast and seeking freight. Some go to India for grain or jute, others to Burmah for rice, others to Java for sugar, some to Buenos Ayres for wheat, some are even compelled to go to the United States.

In Australia the same conditions are repeated. This commonwealth imports iron, lumber and general manufactures, and exports wool, hides and meat, all of them several times as valuable per ton as the staple imports. Sometimes there is a small export of wheat, but there is usually a large surplus of shipping that must fall back upon coal, which fortunately Australia possesses at Newcastle, 60 miles north of Sydney. With this cargo many vessels go to East Indian and Oriental ports—Batavia, Sourabaya, Singapore, Manila, Hong Kong. After discharging the coal they can sometimes reload directly, but often another though shorter ballast voyage must be made to secure a cargo of Java sugar, Manila hemp, Siam or Burmah rice or even Indian jute, grain and seeds. From Newcastle (Australia) other vessels, usually sailers, depart to Hawaii for sugar or to San Francisco, Portland or Puget Sound for wheat. Others, both sail and steam, carry coal cargoes to northern Chile for nitrate of soda. By these various routes a large proportion, possibly a half, of the vessels that go out on the South African trunk route return to the North Atlantic by another way.

China and Japan are likewise countries with a surplus of outgoing shipping, and Japan is an exporter of coal that is in common use as far south as Singapore, and it is sometimes sent to Hawaii and the Pacific coast of the United States. The surplus shipping of East Asia usually seeks cargo in the Philippines, Java or the United States; some vessels crossing the North Pacific and transferring themselves from the Mediterranean-Asiatic trunk to the South American by way of the American-Oriental.

Triangular voyages are often made in these transfers from route to route. Such a triangle in the North Atlantic is very pronounced.

Brazil exports coffee very largely to the United States, and as the return cargo is light, many of the coffee ships load in American ports for Europe and return thence with European goods to Brazil, completing a triangular voyage. Voyages of a triangle character are often made by tramp vessels, and many of them can be figured out from the examples given above, but none of the many triangular voyages are so plain, so unobstructed and so nearly equilateral or so systematically followed as the Atlantic triangle.

The balance among the routes will be very much disturbed by the opening of the Panama canal, which will give such an added opportunity for vessels to take shorter routes and to switch from route to route as indicated by the accompanying table of distances.

TABLE OF DISTANCES.

To	New York via— Present route.	New York via— Panama Canal.	New York via— Saving by Canal.	New Orleans via— Present route.	New Orleans via— Panama Canal.	New Orleans via— Saving by Canal.	Liverpool via— Present route.	Liverpool via— Panama Canal.	Liverpool via— Saving by Canal.
San Francisco	I., II. 13,714	5,299	8,415	I., II. 14,114	4,698	9,416	I., II. 14,084	8,038	6,046
Yokohama	III. 13,564	IV. 9,835	IV. 3,729	III. 14,929	IV. 9,234	IV. 5,640	III. 11,640	IV. 12,574	IV. —934
Shanghai	III. 12,514	V. 10,885	V. 1,629	III. 13,879	V. 10,284	V. 3,595	III. 10,580	V. 13,624	V. —3,044
Manila	III. 11,601	V. 11,585	V. 16	III. 12,966	V. 10,984	V. 1,982	III. 9,677	V. 14,324	V. —4,647
Sydney	VI. 13,658	VII. 9,814	VII. 3,844	VI. 14,625	VII. 9,213	VII. 5,412	IX. 12,234	VII. 12,553	VII. — 319
Melbourne	VI. 13,083	VII. 10,022	VII. 3,061	VI. 14,051	VII. 9,421	VII. 4,630	IX. 11,659	VII. 12,761	VII. —1,102
Wellington	VIII. 14,333	VIII. 8,534	VIII. 5,799	VIII. 15,301	VIII. 7,933	VIII. 7,368	X. 12,949	X. 11,273	X. 1,676
Adelaide	XI. 12,575	XII. 10,530	XII. 2,045	XI. 13,543	XI. 9,929	XI. 3,614	XI. 11,151	XI. 13,269	XI. —2,118
Guayaquil	I. 10,425	I. 2,864	I. 7,561	I. 10,823	I. 2,263	I. 8,560	I. 10,722	I. 5,603	I. 5,119
Iquique	I. 9,221	I. 4,021	I. 5,200	I. 9,621	I. 3,420	I. 6,201	I. 9,591	I. 6,760	I. 2,831
Valparaiso	I. 8,461	I. 4,630	I. 3,831	I. 8,861	I. 4,029	I. 4,832	I. 8,831	I. 7,369	I. 1,462
Coronel	I. 8,130	I. 4,836	I. 3,024	I. 8,530	I. 4,237	I. 4,023	I. 8,230	I. 7,577	I. 653

Routes, via:

I. Straits of Magellan.
II. Pernambuco and Callao.
III. Suez Canal.
IV. San Francisco.
V. San Francisco and Yokohama.
VII. St. Vincent, Cape of Good Hope, Adelaide & Melbourne.
VII. Wellington.
VIII. St. Vincent, Cape of Good Hope, and Melbourne.
IX. Suez Canal, Colombo, King George Sound, & Adelaide.
X. Suez Canal, Colombo, King George Sound and Melbourne.
XI. St. Vincent & Cape of Good Hpe.
XII. Wellington and Melbourne.

One of the first of these developments is likely to be the establishment of a new current of round the world traffic for both tramp and liner.

It is now the custom for liners going out from Europe to China to end the voyage at Yokohama. But once in Yokohama, the most economical route for the return is by way of America, provided Panama were passable. The steamers could discharge and receive cargo at Hong Kong and Shanghai, and continue from Yokohama to San Francisco. The freight conditions in this part of the world would favor this practice because the trade from China and Japan toward Europe is much lighter than that going the other way. The steamers at Yokohama are, therefore, in straits for freight, and it would be natural for them to seek the abundant freights of California, and thus adopt the practice that is being, and has been long, followed by many sailing vessels that have discharged cargoes in the ports of East Asia. This prediction is further strengthened by the recent establishment of a line of steamers running from England to China and Japan, and then for the sake of a return cargo going on to Portland and Seattle, securing nearly a full cargo of wheat, returning thence to Asia, where such other cargo as may be secured is added, and the whole carried westward through the Suez Canal to Europe. The Hamburg-America Co. has a service across to San Francisco, and a contract to establish one to Mexico. With the Panama Canal in operation it is scarcely possible that these steamers would return to England by the longer Asiatic route. If the Suez Canal tolls should be as low as those at Panama (which is very unlikely) the use of the American route by regular lines from Japan to Europe would be probable, because the temptation of Pacific coast freight would continue strong and would certainly, as at present, draw many tramp vessels across the North Pacific.

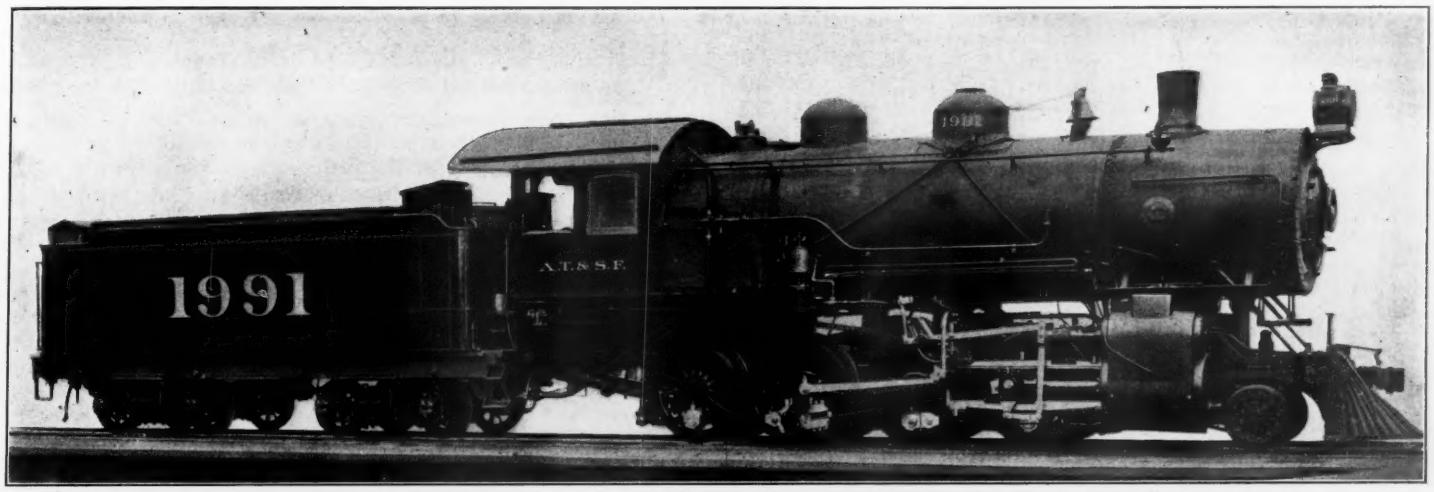
(To be continued.)

The American traveler accustomed to make free with uncomplimentary remarks to train and station men must put a bridle on his tongue in Germany. A merchant with a monthly commutation

ticket traveled on a certain express train from Duisburg to Bochum. His ticket read "good on all trains for which an extra charge is not made." Now a time-table sold on this line named this train as one on which commutation tickets are good. But when he was leaving the train the gateman held him up for 10 cents. After some heated discussion the passenger allowed himself to say: "You stupid fellow; you don't understand your own business." Now it turned out that the gateman did understand his business; and that it was by an error that this train was named in the time-table as available with commutation tickets. Arrest for insulting a public servant; 20 marks fine.

New Locomotives for the Atchison, Topeka & Santa Fe.

The Baldwin Locomotive Works recently completed an order for 49 locomotives for the Atchison, Topeka & Santa Fe. Seven of these are Pacific engines for passenger service, and 42 consolidation, for freight service. All have single expansion cylinders, piston valves, Walschaerts valve motion and smokebox superheaters. Ten of the consolidation locomotives are equipped for burning coal; the remainder, including the Pacific type engines, are arranged for burning oil.



Consolidation Locomotive Built for Atchison, Topeka & Santa Fe, by Baldwin Locomotive Works.

The Santa Fe has been operating for some time a ten-coupled locomotive with a smokebox superheater, and its successful performance has resulted in the adoption of superheated steam at comparatively low pressure on these later engines.

The Pacific locomotives have 25 x 28-in. cylinders and driving wheels 73 in. in diameter, and, as the safety valves are set at 160 lbs., the tractive force is 32,600 lbs. The boiler is straight top, with sloping throat and back head, and tubes 20 ft. long. The barrel is built up of four rings, which have "Diamond" butt joint seams on the top center line. The firebox is radially stayed, and the front end of the crown is supported by two I-irons. All firebox rivets are countersunk on the inside. Washout plugs are liberally provided in the front tube sheet, back head and water legs; also on the lower center line of the barrel, along the water level, and in the outside sheet just below the firebox crown.

The superheater is the type developed by the Baldwin Locomotive Works, and illustrated in the *Railroad Gazette* of June 7, 1907. The final passage of the steam is through the tubes at the back of the smokebox, where the gases are hottest. The arrangement of the drums and tubes is shown in the engraving. The joints between the tube plates and drums are made tight with copper gaskets.

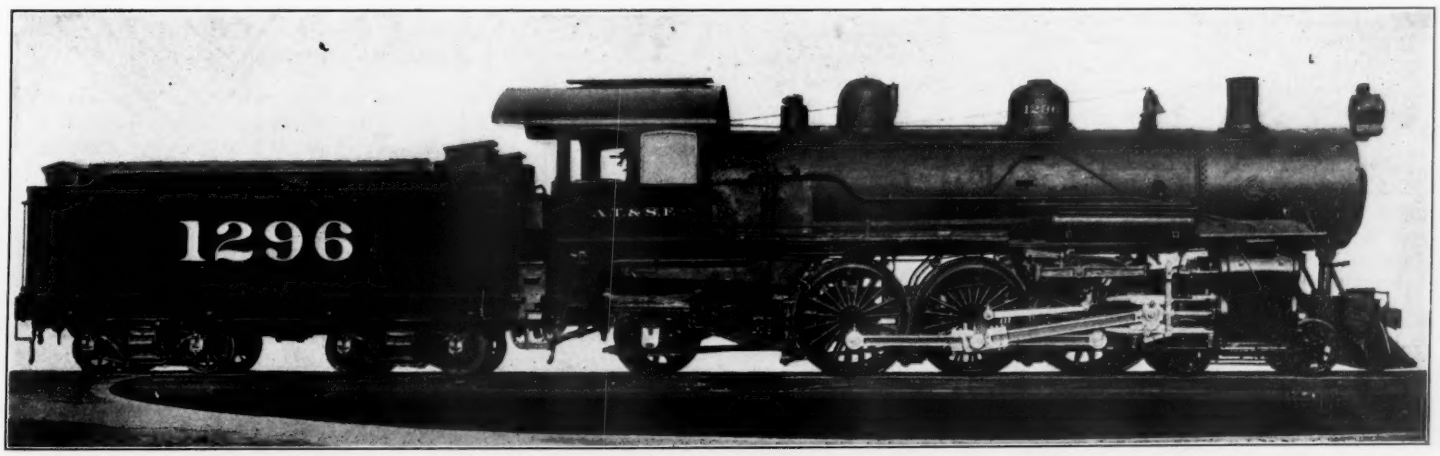
The cylinders are designed for double front rails, and are equipped with inside admission piston valves 13 in. in diameter. The steam chest center lines are 6 in. outside the cylinder center lines. The valves have a steam lap of 1⅛ in., and an exhaust clearance of ⅛ in. They are set with a constant lead of ¼ in. and have 6¼ in. maximum travel. The relief valves are the style used by the Pennsylvania on its piston valve locomotives. The live steam ports extend up to a horizontal face above the steam chest. The ports are covered by a plate, which, when the throttle is open, is held on its seat by steam pressure acting on its upper surface. Should the pressure underneath become excessive, the plate is lifted from its seat, and communication thus established between the two ends of the cylinder.

The location of the steam chests makes it possible to use a direct form of valve motion with all parts placed in practically the same vertical plane. Each link is supported by two cast-steel bearers which are bolted in front to the guide yoke, and at the back to a suitable support. The valve rod is carried on a bearer bolted to the top guide, and is rectangular in section.

The front truck is swing bolster, with cast-steel saddle and three-point suspension links. The rear truck is the Rushton pattern with outside journals. The engine truck and tender wheels are steel-tired with cast-steel spoke centers and were made by the Standard Steel Works.

The tender frame is of 12-in. steel channels with wood bumpers, and the trucks have arch bar frames, cast-steel bolsters and triple elliptic springs. The tank has a water bottom.

The consolidation type locomotives have 24 x 32-in. cylinders, 57-in. driving wheels and 160 lbs. steam pressure, giving them a tractive force of 43,970 lbs. The details are in many respects similar to those of the Pacific locomotives. This is especially true of the cylinders, with their piston and relief valves, valve motion details, and many of the smaller fittings. The link bearings on the consolidation engines are bolted to the guide yoke, which also serves as a support for the reverse shaft bearings. The cast-steel details for both types include frames, wheel centers, driving boxes and spring saddles, cylinder heads, crossheads and foot plates. The



Pacific Locomotive Built for Atchison, Topeka & Santa Fe, by Baldwin Locomotive Works.

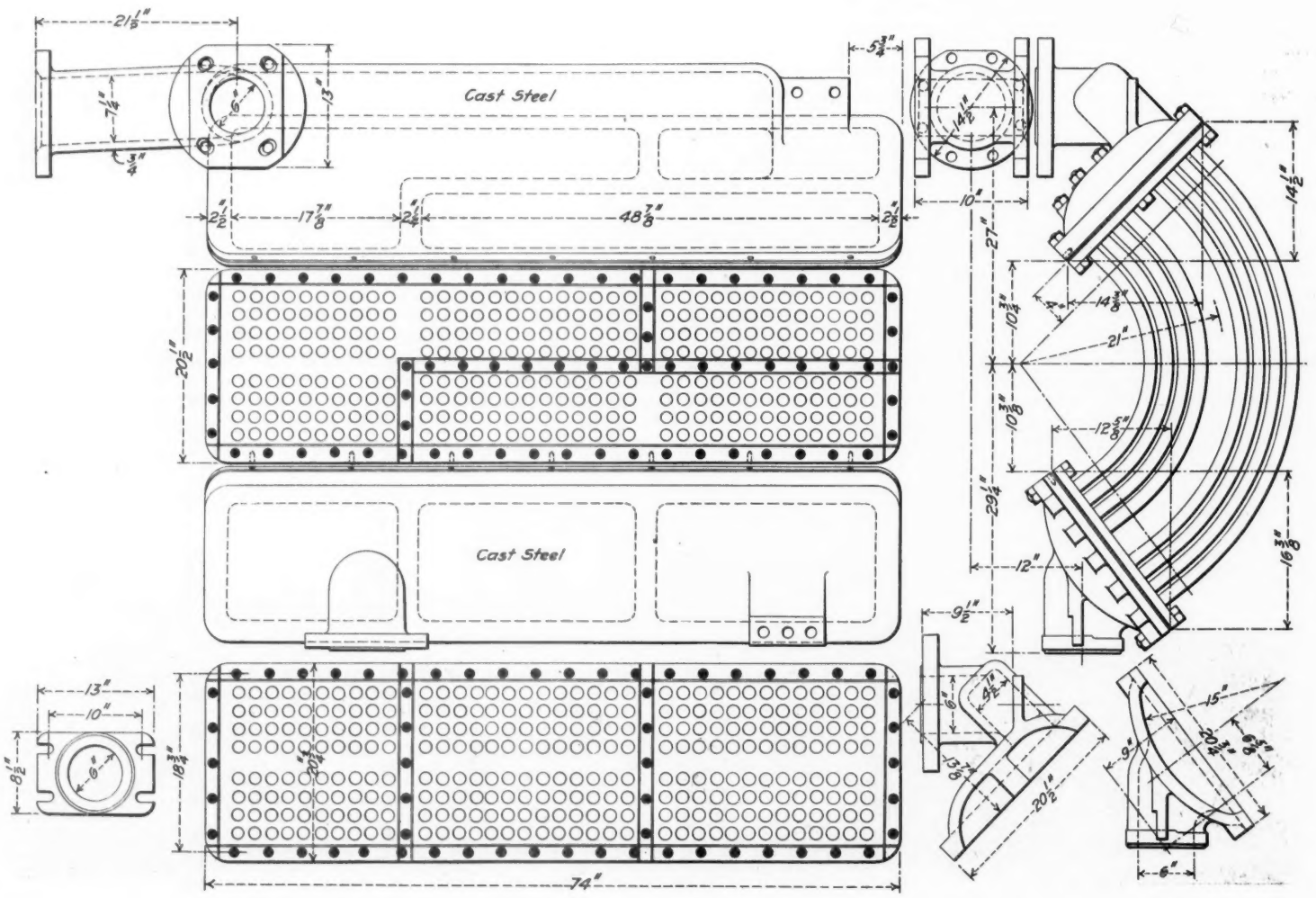
tenders for both passenger and freight locomotives are similar throughout.

The photographs and erecting drawings show the general features of the two classes, and the principal dimensions are given in the following tables:

	Pacific.	Consolidation.
Cylinders, diameter	25 in.	24 in.
Piston, stroke	28 "	32 "
Boiler, diameter	72 "	78¾ "
Boiler, thickness of sheets	5/8 x 11/16 in.	11/16 x 3/4 in.
Steam pressure	160 lbs.	160 lbs.
Fuel	Oil.	Oil.
Firebox, length	107 15/16 in.	95½ in.
" width	66 in.	71¼ "
" depth, front	75⅞ "	73⅛ "
" depth, back	67⅝ "	62⅞ "
" thickness tube sheets	5/16 "	7/16 "
Back crown sheets	3/8 "	5/8 "
Water space front	4½ "	4½ "
" " sides	5 "	4 "
" " back	4 "	4 "
Tubes, thickness	No. 11.	No. 11.
" number	273	355
" diameter	2¼ in.	2 in.
" length	20 ft. 0 in.	15 ft. 0 in.
Heating surface, firebox	190 sq. ft.	157 sq. ft.
" " tubes	3,202 "	2,773 "
" " total	3,392 "	2,930 "
" " superheater	759 "	600 "
Grate area	49.5 "	47.4 "
Wheels, diameter, driving	73 in.	57 in.
" " front truck	34¼ in.	29¼ in.
" " back truck	50 in.	.....
Journals, main, driving	10 x 12 in.	10 x 12 in.
" trailing, driving	9 x 12 "	9 x 12 "
" front truck	6 x 10 "	6½ x10½"
" back truck	8 x 14 "	.....
" tender	5½ x 10 "	5½ x 10 "
Wheel base rigid	12 ft. 8 in.	15 ft. 6 in.
" " total	34 " 5 "	24 " 6 "
" " engine and tender	65 " 0 "	58 " 3 "
Weight on drivers	140,400 lbs.	183,200 lbs.
" " front truck	54,950 "	29,200 "
" " back truck	37,400 "	..... "
" total	232,750 "	212,400 "
" engine and tender	395,000 "	375,000 "
Tank capacity, water	8,500 gals.	8,500 gals.
Tank capacity, oil	3,300 "	3,300 "
Tractive effort	32,600 lbs.	42,970 lbs.
Weight on drivers / Tractive effort	4.31	4.26
Total weight / Tractive effort	7.08	4.94
Tractive effort x diameter drivers / Heating surface	701.29	835.93
Heating surface / Grate area	68.52	61.81
Firebox heating surface / Total heating surface	5.60*	5.36*
Weight on drivers / Total heating surface	41.39	62.52
Total weight / Total heating surface	68.61	72.49
Volume of both cylinders, cu. ft.	15.91	16.76
Total heating surface / Volume of cylinders	213.20	174.82
Grate area / Volume of cylinders	3.11	2.83
Tube heating surface equated to firebox heating surface (Vaughan formula), sq. ft.	716.33	716.53
Totl equated firebox htg. surf.,sq.ft.	906.33	873.53
Total actual heating surface / Total equated heating surface	4.73	3.35

*Per cent.

It is interesting to note that the steam pressure has been cut down from the 180 or 200 lbs. that is the prevailing practice in this country to a figure where boiler maintenance and repairs are more economically effected. This is also nearer the most economical figure for steam consumption as established by the investigations of Prof. Goss, although somewhat below that pressure. In the equating of the tube to firebox heating surface by the Vaughan formula, it will be seen that the figures are almost the same, being within a fraction of a foot, showing markedly the relation between tube length and number of tubes. In this case, the tubes of the Pacific engine are one-third longer than those of the consolidation, while the latter engine has 30 per cent. more tubes. The ratios do not, however, hold exactly, because of the larger diameter of the tubes in the Pacific engine; but the ratio is suggestive of the alternative offered the designer.



Drums and Tubes of Baldwin Smokebox Superheater; Atchison, Topeka & Santa Fe.

GENERAL NEWS SECTION

NOTES.

The Attorney-General of Nebraska has begun suits in the Supreme Court of the state to enforce the Sibley act reducing express rates 25 per cent.

According to a circular recently issued to stockholders in the Chicago Subway Co. the company now has 90 connections with freight producing points.

Western Colorado believes it can grow the finest potatoes in the world, and the Denver & Rio Grande is sending a special train around to give instructions in the art.

R. C. Richards, Claim Agent of the Chicago & North-Western, says that out of 110,000 claims presented last year for loss and damage the road paid 40,000 on the spot.

Proportional rates on grain and grain products from St. Louis to Trunk Line territory have been established by the Wabash, the Clover Leaf, the Alton and the Chicago, Peoria & St. Louis.

Owing to the action of Georgia lawyers in attempting to tie up the funds of the Southern Railway by garnishment and attachments for damage suits, the company has withdrawn its depository funds from the state of Georgia.

Nine railroads in the New England Car Service Association report that 93.6 per cent. of the cars handled in February, 1908, were released within the allowed limit of 96 hours. The proportion for September, 1907, was 92.6 per cent.

The Missouri Pacific has notified the Nebraska Railroad Commission that it will give to shippers of corn and wheat a rate to St. Louis equal to the local rates through Nebraska, and not compel them to ship by way of Omaha at a greater rate.

The Great Western Railway Company, of England, has established an office in the Times building, New York, to afford information to tourists who intend visiting the British Isles and to shippers. T. Kateley has been made General Agent for the United States.

Five special farmers' trains from the East and South came into Winnipeg on March 20. A continuously heavy movement of farming settlers from the United States is reported, most of the settlers coming from Illinois, Ohio, Indiana, Iowa, Nebraska, Minnesota and the Dakotas.

The New York City Public Service Commission on March 19 held that passengers on steam railroads within the city limits of New York need not pay the 10 cents excess fare charged them by the conductors of the train if they fail to purchase their tickets at the ticket office.

The chairman of the Michigan Railroad Commission is quoted as saying that the commission will be lenient for 60 or 90 days and will then be disposed to raise objection to the closing of small stations by railroads in the state in order to reduce expenses under the nine-hour law.

The Canadian Pacific announces that it will grant party rates for parties of ten or more traveling on a single ticket from points in eastern Canada to the Northwest, west of Winnipeg, and to Seattle, Tacoma and Portland on a basis of one fare for the round trip by the all-Candian route.

The Interstate Commerce Commission has sent a communication to the House of Representatives in which it estimates that the supervision of railroad accounts under the present Interstate Commerce Act will cost the government $750,000 a year. How much it will cost the railroads, it does not estimate.

The Texas & Pacific has advised the Texas Railroad Commission that it will be unable to comply with the Commission's betterment requirements on account of the condition of the money market. Counsel for the road points out that improvements have been ordered which are unnecessary in a period of slight traffic.

The Interstate Commerce Commission has intervened in the controversy between the receivers of the Chicago Great Western and the employees of the road. The receivers have been requested to take no further action until the commission has had an opportunity to use its friendly offices to secure an amicable adjustment.

The Attorney-General of Wisconsin has advised the railroad commission that railroad companies operating in Wisconsin have no authority to charge more than 2 cents per mile for carrying passengers unless they make proper provision for refunding the excess charge. The question was raised by the application of a railroad for permission to require passengers who have an opportunity to purchase tickets, but fail to do so before boarding trains, to pay something in addition to the schedule fare.

Instructions have been sent to the station agents on the El Paso & Southwestern that they will be held responsible for bundles and packages checked from their stations as baggage when they do not come under the company's definition of the term, and that they will have to pay the express charges on such articles if reported by the express companies.

As a result of the ocean rate war, the North German Lloyd Steamship Co. reports annual earnings of $8,174,250, gross, as against $9,829,500 in 1907. The company has declared a 4½ per cent. annual dividend, as compared with 8½ per cent. last year, and has carried forward considerably less than half of the reserve that was carried forward in 1907.

What is known as the Hepburn bill, to amend the Sherman Anti-Trust law, was introduced in the House of Representatives on March 23. The bill provides, among other things, that corporations which file news of contracts and agreements with the proper federal authority are to have immunity from prosecution under the Anti-Trust law if these contracts and agreements are approved.

Following the meeting of the Transcontinental Passenger Association, the Harriman lines and the Atchison, Topeka & Santa Fe have given notice of independent action on tourist rates to the Pacific coast this summer. As against the 2-cent-a-mile basis advocated by the northern lines, the southern lines stood out for a basis similar to that applying to common points in Colorado. From Chicago the round trip rate to coast points between San Diego, on the south, and Vancouver, on the north, will be $72.50.

A bill has been introduced in both houses of the New York legislature to place telegraph and telephone companies and ferry and stage line companies under the jurisdiction of the Public Service commissions. A provision is also inserted in the bill to enable the New York City commission to proceed against the street railway corporations of New York for the forfeiture of rights they claim on certain streets in the downtown section if the commission decides that the corporations are exercising franchises without authority, or have abandoned or do not use all or part of their franchises. Provision is also made for giving the commission the power to audit accounts and to decide, after hearing, how outlays and receipts shall be charged and credited.

Pennsylvania Steel Coaches.

The first one of the 200 all-steel passenger cars ordered by the Pennsylvania last year has just been placed in service between New York and Philadelphia. This coach is 70 ft. long. Aside from the mahogany window sash and seat frames, there is no wood whatever in the coach. It seats 88 persons and weighs 53 tons. It is one of 25 being built at Altoona; the rest of the order was placed with the Pressed Steel Car Co. and the American Car & Foundry Co. These cars were described in the *Railroad Gazette* of June 14, 1907.

President Newman on the Railroad Situation.

The following comments are taken from an advance proof of the current annual report of the New York Central & Hudson River:

The tendency to regulate railroads and the details of their business has been shown in many federal and state laws, either enacted or proposed. The Interstate Commerce Commission and the public service commissions which have been established in a number of the states, have been given indefinite and almost arbitrary power. Hours of labor have been shortened by law, rates of fare have been reduced, liability for accidents has been increased, and in ways too numerous to mention, burdens have been placed on railroad companies which other corporations are not subjected to, and their ability to bear them has been lessened. While the enactment of just and equal laws is of the highest importance to railroads, much of the recent legislation has not been preceded by intelligent study or investigation and has been passed without reference to practical results. Uncertainty as to the effect of these new laws, and doubt as to how far regulation and special legislation as to railroads is to be carried, has without question been one of the causes which have unsettled the value of securities and helped to bring on the present period of depression.

The great expansion of business throughout the country during the period of prosperity which ended in October last brought to this company a rapid increase in the volume of traffic. There has been a continued growth in gross earnings for several years past, but this has been due to increase in the amount of business rather than to an

increase in rates. Incident to good times, in order to handle the growing volume of traffic, facilities had to be quickly enlarged at great expense and the number of employees increased. Meanwhile wages and the cost of material rose to a level never before reached in recent years. When, therefore, late in the fall of 1907 depression set in, it was at once felt by this company as well as by all other lines, and gross earnings fell off suddenly and heavily. It was impossible to reduce expenses at once to correspond with the shrinkage in gross revenue.

Minnesota and North Carolina Laws Upset.

On March 23 the United States Supreme Court found the new railroad law of Minnesota and of North Carolina unconstitutional.

In the Minnesota case the controversy arose over the enactment of the 2 cent rate law and the excessive penalties that were provided against the railroads or their officers who refused to comply with its terms—$5,000 fine and five years' imprisonment for each refusal to sell a ticket at the rate named, and over the commodity rates, which were to have gone into effect June 1 last, reducing substantially the rates on certain merchandise and prescribing the minimum weights for carloads. Before that date, however, certain stockholders of the Northern Pacific road brought suit in the Federal Court for the District of Minnesota to enjoin the Attorney-General of the state from putting the rates into effect. That official appeared for the special purpose of objecting to the jurisdiction of the court, contending that it was without authority because the suit was in effect one against a state, prohibited by the Eleventh Amendment. This demurrer was overruled and an order was issued enjoining the enforcement of the rates until it could be determined judicially whether or not they were confiscatory, as claimed by the stockholders.

Attorney-General Young, however, paid no attention to the injunction, but the next day instituted in the state courts proceedings to compel the Northern Pacific to adopt the commodity rates prescribed. When this action was brought to the attention of the Federal Court, the Attorney-General was arrested and after a hearing, in which he again set up his immunity under the Eleventh Amendment, he was adjudged in contempt of the Federal Court, fined $100 and committed to the custody of the United States Marshal until paid and he should purge himself by withdrawing the suit from the state court. Instead he applied to the Supreme Court for a writ of habeas corpus for his release.

Justice Peckham, who delivered the opinion, said that the lower court was given jurisdiction in suits arising under the laws and the Constitution of the United States, and the question really to be determined was whether the acts of the Legislature, if enforced, would take property without due process of law, and the question might incidentally involve a question of fact; its solution, nevertheless, was one that raised a Federal question. The sufficiency of rates with reference to the Federal Constitution, he said, was a judicial question and one over which the Federal courts had jurisdiction, and had been settled by a long line of decisions.

Quoting from prior decisions that a law was invalid where it imposed a remedy so difficult to enforce as to be no remedy at all and that a rate was unconstitutional where the decision of the Legislature or its commission was conclusive as to the sufficiency of the rates, Justice Peckham said that a law which indirectly accomplished a like result by imposing such conditions upon the right to appeal for judicial relief as worked an abandonment of the right rather than face the conditions upon which it was offered or might be obtained was also unconstitutional. He continued:

It may, therefore, be said that when the penalties for disobedience are by fines so enormous and imprisonment so severe as to intimidate the company and its officers from resorting to the courts to test the validity of the legislation the result is the same as if the law in terms prohibited the company from seeking judicial construction of laws which deeply affect its rights.

For that reason the court holds the Minnesota freight and passenger rates to be unconstitutional on their face without regard to the question of the sufficiency of those rates. The Circuit Court, therefore, had jurisdiction and it was its duty to inquire whether the rates permitted by those acts were too low and therefore confiscatory, and if so held that the court then had jurisdiction to permanently enjoin their enforcement. It also had power while the inquiry was pending to grant a temporary injunction to the same effect.

Referring to the affidavits submitted in the case showing that the rates were confiscatory the opinion continues:

We have, therefore, upon this record the case of an unconstitutional act of the state legislature and an intention by the Attorney-General of the state to endeavor to enforce its provisions to the injury of the company, compelling it at great expense to defend legal proceedings of a complicated and unusual character and involving questions of vast importance to all employees and officers of the company, as well as to the company itself. The question that arises is whether there is a remedy that the parties interested may resort to by going into a federal court of equity in a case involving a violation of the federal constitution and obtaining a judicial investigation of the problem, and pending its solution obtain freedom from suits, civil or criminal, by a temporary injunction; and if the question be finally decided favorably to the contention of the company a permanent injunction restraining all such actions or proceedings.

This inquiry necessitates an examination of the most material and important objection made to the jurisdiction of the Circuit Court, the objection being that the suit is in effect one against the state of Minnesota and that the injunction issued against the Attorney-General illegally prohibits state action, either criminal or civil, to enforce obedience to the statutes of the state.

In the lower court, says the opinion, the case had proceeded on the theory that the rights of the stockholders protected by the Fourteenth Amendment would be violated if the rates were enforced.

A decision in the case, however, did not require a decision of the question whether the adoption of that amendment in any way altered or limited the effect of the Eleventh Amendment prohibiting a suit against a state.

The general discretion regarding the enforcement of the laws when and as the District-Attorney deems appropriate is not interfered with by an injunction which restrains the state officer from taking steps toward the enforcement of an unconstitutional enactment to the injury of complainants. In such case no affirmative action of any nature is directed and the officer is simply prohibited from doing an act which he had no legal right to do. An injunction to prevent him from doing that which he has no legal right to do is not an interference with the discretion of an officer.

If the act which the Attorney-General seeks to enforce be a violation of the federal constitution the officer in proceeding under such enactment comes into conflict with the superior authority of that constitution and he is in that case stripped of his official or representative character and is subjected in his person to the consequences of his individual conduct. The state has no power to impart to him any immunity from responsibility to the supreme authority of the United States.

Justice Harlan dissented from the majority opinion, on grounds of states' rights.

Railroad Earnings; July, 1907, to January, 1908.

The report of railroad earnings to the Interstate Commerce Commission do not admit of a comparison with the earnings of previous years, but they are now beginning to be useful as a means of studying developments in the business of transportation for a number of months past. Gross and net earnings of practically all the railroads in the country by months, from July 1 to December 31, are now available, and the figures for January cover the earnings of 183,400 miles of road out of a total of something over 224,000 miles.

For the sake of accurate comparison the earnings have been reduced in the subjoined table to a per mile basis. The January figures are affected more or less by the fact that approximately 19 per cent. of the total mileage of the country is not included, but the portion included is so substantial that the gross and net earnings per mile are probably not far from what the complete figures will show. The net figures given represent the operating income after taxes. The operating ratio represents the proportion of strictly operating expenses, exclusive of taxes, to gross earnings:

	Gross.	Net.	Op. ratio.
January	$770	$153	76.4
December	863	198	73.5
November	983	262	70.1
October	1,117	339	66.8
September	1,048	314	67.0
August	1,079	345	65.2
July	1,022	304	67.2

Gross earnings reached their maximum in October, but net earnings were not at their highest in that month, having been $6 per mile or a little less than 2 per cent. under the net returns of August. Taking the October earnings to represent the high tide of railroad prosperity the falling off in three months, as shown by the January figures, was 31 per cent. in gross earnings and 55 per cent. in net earnings after taxes. The successive operating ratios indicate how slow the railroads were to reduce expenses proportionately to the loss of business.—*Wall Street Journal.*

Passenger Travel on the Great Lakes.

In the eighth inspection district, 11,915,345 passengers were carried by vessels during the season of 1907. The passenger traffic originating at Detroit, which forms a part of the eighth district, embraced 7,805,558 of these persons. The number of passengers carried out of Chicago by water was 1,967,994. The number of persons transported on the ferries enters into the total carried out of Detroit. In the entire district there was the loss of but a single life among passengers, and that was occasioned by the burning of a boat in Lake Michigan.—*Detroit Free Press.*

Report of United States Steel Corporation.

Gross sales and earnings of the United States Steel Corporation in the year ended December 31, 1907, were $757,000,000, against $697,000,000 in 1906. Net earnings were $161,000,000, against $157,000,000 in 1906. The balance applicable for dividends on the common stock or for new construction amounted to $79,000,000, or 15.6 per cent. on the common stock, as against $73,000,000, or 14.3 on the common stock in 1906. The total profit and loss surpluses of the corporation and its subsidiaries on December 31, 1907, was $123,000,000. This surplus stood at $98,000,000 a year earlier. The

appropriations for new construction amounted to $54,000,000, as against $50,000,000 in 1906. There were 22,400,000 tons of iron ore mined during the year, as against 20,600,000 tons in 1906. The corporation sold 1,734,000 tons of steel rails in 1907, as against 1,983,000 tons in 1906. The average number of employees in service was 210,180, compared with 202,457, in 1906. The number of blast furnaces was 116, as against 97 in 1906.

Boycott Injunction Made Permanent.

The restraining order and injunction issued against the American Federation of Labor and its executive counsel, their agents, attorneys, servants, etc., at the instance of Buck's Stove and Range Company of St. Louis, by Justice Gould, of the Supreme Court of the District of Columbia in December last, were made permanent March 23 by Chief Justice Clabaugh. The signing of the decree was the result of agreement of counsel for both sides, although an appeal was taken by the Federation as a legal safeguard in case of possible developments in the future.

The decree is practically identical with that signed by Justice Gould in December. It restrains the Federation, its executive counsel, etc., from publishing the Buck's Stove and Range Company under its "We Don't Patronize," or "unfair" list, and prohibits them from boycotting or in any manner interfering with the stove company's business or with the sale of its product or of coercing or attempting to coerce any person, firm, corporation or the public from dealing in an unrestricted manner with the company.

Lectures on Railroad Electrification at the University of Michigan.

C. L. de Muralt, Consulting Engineer and Professor of Electrical Engineering at the University of Michigan, is giving a course of lectures to the senior electrical engineering students at Ann Arbor on the "Electrification of Steam Railroads." During the last term he has taken up such subjects as power station equipment, transmission and working conductors, motor characteristics, etc. He intends to supplement these by discussions of the technical and commercial features of the following subjects: "The General Electrification Problem"; "The Reasons for Electrification"; "The Operating Characteristics of Steam and Electric Locomotives"; "The Choice of Electric Systems"; "An Analysis of the Cost of Operation"; "The Field of Railroad Electrification: the Congested Terminal, the Mountain Grade, and the Trunk Line"; and "Preparation of an Electrification Project for a Particular Road," special attention being directed to such problems as the design of locomotives, the calculation of run sheets, the choice of speeds, study of the peak load, the location of substations, the economics of transmission and other collateral topics.

INTERSTATE COMMERCE COMMISSION RULINGS.

Rate Reduced on Coke from Colorado to Texas.

The Commission, opinion by Chairman Knapp, has announced decision in the case of the Amarillo Gas Co. vs. Atchison, Topeka & Santa Fe et al. The Commission held that defendants' rate of $3.35 per ton of 2,000 lbs. on coke in carloads from the Trinidad coal and coke district in Colorado to Amarillo, Tex., is excessive and unreasonable and should not exceed $2.90 per ton, the rate now in force for the transportation of soft coal between the same points.

Rates on Snapped and Shelled Corn.

The Commission, opinion by Commissioner Cockrell, has announced decision in the case of the Ocheltree Grain Co. vs. Chicago, Rock Island & Pacific. The complaint charged that an unreasonable rate was exacted on shipments of snapped corn, or corn in the shuck, the rate collected being 125 per cent. of the shelled corn rate. It was alleged that snapped corn is less valuable in proportion to weight, 72 lbs. making a bushel, than shelled corn, of which 54 lbs. make a bushel. At the hearing it appeared that the carrier had changed the rate on snapped corn to that on shelled corn. The Commission decided that the carrier, having changed the rate complained of, should keep its present rate on snapped corn in effect for two years.

Poor Location No Reason for Lower Rates.

The Commission, opinion by Chairman Knapp, has announced decision in the case of S. S. Quimby et al. vs. Maine Central and Washington County Railway. The complainants, situated in the eastern part of Washington county, Me., alleged that by reason of their location they cannot take advantage of the milling-in-transit privilege on corn, although their competitors at Bangor and Lewiston, Me., can do so, and therefore allowance of the transit privilege at Bangor and Lewiston constitutes undue discrimination against them.

The Commission declared that the disadvantage under which complainants labor is primarily due to their unfavorable location and that it is not the province of the Commission to overcome disadvantages of this nature by adjustment of transportation charges. If the privilege were denied to complainants and allowed to their competitors, the discrimination so practised might be unlawful; but no such claim was made.

Through Route and Joint Rate Ordered.

The Commission, opinion by Chairman Knapp, has announced decision in the case of the Merchants Freight Bureau of Little Rock, Ark., vs. Midland Valley and Chicago, Rock Island & Pacific. The complainant asked the Commission to establish through routes and joint rates for the transportation of cotton seed in carloads from points on the Midland Valley in Oklahoma, namely, Williams, Panama, Bokoshe, Keota, Stigler, Porum, Warner, Keefeton, Muskogee, Taft, Haskell, Elder and Tulsa, to Little Rock, Ark., via the Midland Valley and the Rock Island. The Commission decided that the failure of defendants to establish such routes and rates unduly discriminates against complainant in favor of manufacturers at Fort Smith, Ark., and Muskogee, Okla., and ordered defendants to establish a through route for the transportation of cotton seed in carloads from such points in Oklahoma over the Midland Valley to Hartford, Ark., and thence over the Rock Island to Little Rock, Ark., and to apply to such transportation joint through rates which as to each of said points of origin shall not exceed the present local charge of the Midland Valley from such shipping point to Hartford plus the present local charge of the Rock Island from Hartford to Little Rock.

Marine Insurance on Lake and Rail Shipments.

The Commission, opinion by Commissioner Prouty, has announced decision in the case of Wyman, Partridge & Co. et al. vs. Boston & Maine et al. This decision is a novel one in that it discusses the question of marine insurance. It seems that prior to the opening of navigation in 1907, shippers provided marine insurance on their rail and lake shipments from New York City to Chicago and Minneapolis, but after that time such rail and lake rates were advanced and the cost of insurance was included in the rates.

The Commission decided that unless a railroad forming part of a lake and rail route sees fit to hold itself responsible for losses arising from perils of the sea, it should tender to the public a transportation contract which leaves shippers free to arrange for their own marine insurance. The bill of lading issued did not show definitely the rights of the shippers. The Commission held that the advanced rates are unreasonable and should be reduced unless the carriers issue bills of lading making them definitely responsible for loss by perils of the sea. The opinion contains a table showing the exact reductions recommended, but no order will be made until May 1, 1908. An order will then be issued putting in the reduced rates above named unless the defendants have previously tendered a contract of shipment under which the shipper receives the same protection which he formerly had under his policy of marine insurance, and make the necessary changes in their tariffs, if any are required.

New Suit Necessary to Get Lower Rate.

The Commission, opinion by Commissioner Prouty, has announced decision in the case of the Merchants Traffic Association of Denver, Colo., vs. New York, New Haven & Hartford and 17 other carriers. The complaint alleged that the all-rail rate on cotton piece goods from New England points to Denver of $1.79 per 100 lbs., in any quantity, is unreasonable, and prayed that Denver be accorded a carload rate on such cotton fabrics. The Commission decided that the application for a carload rating be denied, but that the $1.79 rate is excessive and should not exceed $1.50.

This rate to Denver is not a joint through rate, but is made up of the local rate from New England to St. Louis plus the rate from St. Louis to Denver, or in some cases from St. Louis to Kansas City and from Kansas City to Denver. The Commission said that it might perhaps order a reduction of these several locals to such an extent as to bring the entire rate within the figure named by the Commission; but in that case the Commission would be passing upon a through rate from New England to Denver and no such rate is now in existence. The proper method to follow in cases like this, where no joint rate exists, is to cite before the Commission the proper defendants and pray for the establishment of a through route and joint rate. On a petition of that sort the Commission has power to do justice both to Denver and between the different participating carriers.

The complainant then offered the findings of the Commission and insisted that this ought to be sufficient to establish its right to an order, but the Commission held that the entire matter must

be tried *de novo*. As no order could properly be made on the record in this case the complaint was dismissed.

The Commission's Authority in Oklahoma.

The Commission, opinion by Commissioner Lane, has announced decisions in seven cases, namely, A. T. Haines vs. Chicago, Rock Island & Pacific et al.; Kingfisher Mill & Elevator Co. vs. Chicago, Rock Island & Pacific and the Choctaw, Oklahoma & Gulf; Oklahoma Mill Co. vs. the same carriers; Schowalter & Company vs. the same carriers; J. P. Gist vs. the same carriers; Enid Ice & Fuel Co. vs. Chicago, Rock Island & Pacific; Enid Ice & Fuel Co. vs. Fort Smith & Western, and W. B. Johnston vs. Chicago, Rock Island & Pacific.

The findings of the Commission in these decisions are: The Commission is the creature of statute and its authority is derived from the act of Congress creating it. Its function is to administer the Rate Law and not to enforce conditions found in federal or other charters. It is not its province to enforce compliance with conditions subsequent, found in railroad charters. Since the admission of Oklahoma as a state the Commission is without power to fix rates to be observed in the future within the present limits of that state.

Rates between points within the present limits of Oklahoma were held not unreasonable at the time shipments in question moved. The present rate of $1.85 per ton on shipments of slack coal from Weir and Midway, Kansas, to Goltry, Okla., is unreasonable and should not exceed $1.50 per ton. Rates between other points outside the present state of Oklahoma and points within that state held not unreasonable.

Coal Rates from Clinch Valley and Pocahontas Fields.

The Commission, opinion by Commissioner Lane, has announced decision in the case of the Raven Red Ash Coal Co. et al. vs. Norfolk & Western. Complainants are engaged in mining coal in the vicinity of Raven, a station in Virginia, on the Clinch Valley division of the Norfolk & Western. The question was whether the rate on coal in carloads from these mines to the eastern seaboard bears a proper relation to the rate charged from what are known as the Pocahontas and Tug River coal fields, which lie along the Pocahontas division of the Norfolk & Western for about 56 miles west of Graham, W. Va., the junction point of the two divisions. To reach the eastern seaboard, the movement from the mines is interstate, the coal being hauled through West Virginia. The rate on coal from mines on the Clinch Valley division to the eastern seaboard is 10 cents per ton more than from mines on the Pocahontas division. Complainants asked that the rate on coal from their mines on said Clinch Valley division to the eastern seaboard should be the same as that of their competitors in the Pocahontas fields, the distances being substantially the same.

The Commission was of opinion that complainants are entitled to the relief prayed for, and that their mines are entitled to the same rate on coal in carloads eastbound as is charged from the Pocahontas-Tug River coal fields, but held that no money damages should be allowed complainants on the shipments made. The Clinch Valley division for purposes of coal rates should be divided into two groups, one extending from Graham to a point 17 miles west of Raven and the other from Graham to Norton.

Joint Rate With Electric Railway Ordered.

The Commission, opinion by Commissioner Harlan, has announced decision in the case of the Cedar Rapids & Iowa City (Electric) Railway vs. Chicago & North-Western. This is a case where the Commission ordered through routes and joint rates to be established between an electric railway and a steam railroad. It appeared on complaint of failure by the steam railroad company to establish through routes and joint rates with the electric line between interstate points, that the shipping communities at points on the electric line between Coralville, Iowa, and Cedar Rapids, Iowa, do not enjoy the benefit of any reasonable or satisfactory through route from and to Chicago and other points reached by the defendant steam railroad.

The Commission held that through routes and joint rates thereover which shall not exceed by more than 10 per cent. the class and commodity rates of defendant between Chicago and common points and Cedar Rapids, should be established and maintained for the transportation of interstate traffic from and to Coralville and on all other points on the electric line intermediate to Cedar Rapids, to and from Chicago and other points on the line of the North-Western via the junction point between the two roads at Cedar Rapids. A former decision of the Commission in regard to the Chicago & Milwaukee Electric Railway was cited and affirmed and the distinction made between the transportation requirements of mere loading points serving one or more farms, as described in that case, and the more extensive requirements of small centers where general merchandising is done and the products of the countryside are concentrated for shipment, and coal, lumber and other commodities are brought in to supply local needs.

The Baltic Pool.

The Commission, opinion by Commissioner Lane, has decided the case of the Cosmopolitan Shipping Co. vs. Hamburg-American Packet Co., North German Lloyd Steamship Co., Wilson (Hull) Lines and Scandinavian-American Line. The Commission's own digest of the case is as follows:

1. Complaint alleges that defendant steamship companies transport traffic under through bills of lading between inland points of the United States and foreign ports and are thereby subject to the jurisdiction of this Commission; that such defendants have made an arrangement for the pooling of eastbound export traffic moving by rail to Atlantic ports and thence by steamship lines to points in Denmark, Sweden, Norway, Finland and German points on the Baltic; that this "Baltic pool" arbitrarily determines the ultimate rates from such inland points of the United States to such foreign ports via the North Atlantic ports; and that the Hamburg-American Packet Co. maintains a monopoly of westbound and eastbound traffic forwarded on local and on through bills of lading between Germany and other continental countries and inland cities of the United States. The prayer is that the Commission declare the "Baltic pool" to be an illegal pooling of freights under the act, that the monopoly of the Hamburg-American Packet Co. be declared unlawful, and that general relief be granted. To this complaint defendants demur, on the grounds (a) that this Commission has no jurisdiction of the subject-matter, or power to proceed against defendants, and (b) that the complaint sets forth no matter which is cognizable by this Commission, or which it has been given authority to remedy. *Held*, That for reasons stated in the opinion, the demurrer will be sustained and the complaint dismissed.

2. This Commission has no jurisdiction as to shipments moving from ports of the United States to a foreign country not adjacent, when such shipments are not carried by rail, or by rail and water, from an inland point of origin to a port of transshipment. An inland movement of export or import traffic is a condition precedent to the attaching of jurisdiction.

3. The jurisdiction of this Commission is not to be determined by anything other than the language of Section 1 of the Act, and in this section is found a clear distinction drawn between interstate commerce and foreign commerce to a country not adjacent to the United States; and this distinction saves such foreign commerce from the effect of that provision of the section as to continuous carriage beyond the American seaboard.

4. The Commission may regulate interstate traffic, whether by rail or by a combined rail-and-water route, from point of receipt to point of delivery; but the Commission in its control over foreign commerce is limited to the regulation of such traffic, whether by railroad or by a combination of rail and water carriers, from and to the point of transshipment.

5. The Act provides no machinery by which its provisions can be enforced as to trans-Atlantic steamship lines; the absence of such provision can be explained only by accepting the interpretation that the Commission has no jurisdiction in the premises.

6. The pooling of traffic by water carriers is plainly a matter over which this Commission has no jurisdiction.

7. A rail carrier may control, and connect with, a line of steamships engaged in foreign commerce, with which it may interchange business as freely as with another rail carrier, and it may quote a combined rate for the through movement, the agent of the railroad company acting as the agent of the steamship company in so doing.

8. The Act provides that this Commission shall exercise jurisdiction over the inland portion of the haul, either to or from the foreign country; and it must logically and necessarily follow that the rate which must be filed with the Commission under Section 6 of the Act is the rate governing such movement. On foreign commerce the rate to be published with this Commission should be the rate to the port and from the port—an open rate, which any who desire to do so may use with equal advantage.

9. This position does not conclude the Commission against an examination into the relation which exists between the rail carriers of the United States and the defendant water carriers and condemnation of such arrangement, if the rail carriers to the seaboard are by any means whatsoever disobeying any provision of the Act or omitting to comply with its every requirement.

TRADE CATALOGUES.

Protective Coatings.—F. L. Melville, New York, maker of Anti-Rust, is distributing a circular giving prices and setting forth the advantages of this compound. It is for protecting machinery from rust during shipment. It is semi-liquid and the claims for it are that it is proof against salt water and steam, is always ready for

use, will not thin and run off in hot weather, hard rains will not wash it off, it is free from grit, acid and vegetable or animal fats, will not tarnish the most delicate surface and can be removed by simply hard rubbing with waste or rags.

Reamers.—A pamphlet issued by the William J. Smith Co., New Haven, Conn., describes, with price lists, the Smith one-lock adjustable reamer. It is claimed that these can be accurately adjusted in a few seconds, and are as rigid as solid reamers. The blades are made in 14 sizes for reamers from ¾ in. to $3^{3}/_{16}$ in. in diameter. They are fitted with carbon steel or high-speed steel blades. The price lists include prices of each style and size, and of parts. Full dimensions are also given.

MANUFACTURING AND BUSINESS.

E. H. Rayburn, formerly Manager, in the South, for the Philip Carey Manufacturing Co., Cincinnati, Ohio, is now with the Franklin Manufacturing Co., Franklin, Pa.

Falls hollow staybolt iron, made by the Falls Hollow Staybolt Co., Cuyahoga Falls, Ohio, is to be used in the 30 locomotives being built by the American Locomotive Co. for the Paris-Orleans Railroad, France.

A. Johnston, Jr., for two years with the Van Deventer & Rider Co., Chicago, and before that for a number of years in the engineering department of the Chicago & Eastern Illinois, has opened an office as railroad fencing contractor at 152 East Lake street, Chicago.

D. R. Day, Secretary of the Northwestern Malleable Iron Co., Milwaukee, Wis., for the past 10 years, has been made Manager of the Union Malleable Iron Co., East Moline, Ill. The capacity of this company's plant has recently been doubled. The products include both agricultural and railroad material.

H. S. Moulton, formerly Superintendent of the Allison Car Works, Philadelphia, Pa., and more recently connected with the New York office of the Fitz-Hugh, Luther Co., Chicago, is now with the Empire Steel & Equipment Co., New York, the eastern agents for the Hicks Locomotive & Car Works, Chicago.

Arthur E. Rendle, New York, maker of Paradigm skylights and windows, has a new type of fireproof window, the special feature of which is the material composing the frame and casing. This is asbestos wood, a new building material which has been carefully tested and is said to be especially valuable where lightness combined with durability is desired. These windows are finished to represent any kind of wood and can be treated like any wooden or metal frame window.

The Expanded Metal & Corrugated Bar Co., St. Louis, Mo., has received the following orders: Government of the Philippine Islands, 500 tons of corrugated bars, bought through Paul S. Carter, New York; Hiram Lloyd Contracting & Building Co., contractor for the new high school in St. Louis, 500 tons of corrugated bars; William A. Engeman, contractor for the reinforced concrete retaining wall to be built at St. George ferry landing, Staten Island, N. Y., as part of a plan for municipal improvements in the Borough of Richmond, 600 tons of corrugated bars.

James H. Baker, formerly President of the Solid Steel Tool & Forge Co., Brackenridge, Pa., has established an office at 316 Fourth avenue, Pittsburgh, Pa., as a forging engineer, making specialties of forging development, examination of plants, forging and special machinery, the design of forgings and castings, etc. Mr. Baker has been in the forging business for over 20 years. Last December he resigned from the Solid Steel Tool & Forge Co., which had, before that, absorbed the James H. Baker Manufacturing Co.; the latter has been organized in 1900. Several concerns previously founded by Mr. Baker are now merged in other companies.

Iron and Steel.

The New York Central & Hudson River has ordered 24,000 tons of rails from the Lackawanna Steel Co.

The Philadelphia & Reading is said to be about to ask bids on 16,000 tons of steel for track elevation work in Philadelphia.

OBITUARY NOTICES.

Walter L. Surran, Trainmaster of the Cumberland division of the Louisville & Nashville, with headquarters at Middlesborough, Ky., died on March 21 at Corbin, Ky.

James B. Hill, General Freight Agent of the Southwest system of the Pennsylvania Lines West of Pittsburgh, died on March 21 at Biloxi, Miss., at the age of 67. Mr. Hill was born on March 16, 1840, at Indianapolis, Ind., and was educated at Asbury University at Greencastle, Ind., from which he graduated in 1859. When he was 20 years old he began railroad work in the engineering department of the Atlantic & Great Western, now part of the Erie. He left the engineering for the traffic department and in 1868 became traveling agent of the Star Union Line. From 1877 to 1886 he was agent of the Pennsylvania Lines at Milwaukee and in the latter year was appointed General Western Freight Agent of the Pittsburgh, Cincinnati, Chicago & St. Louis at Chicago. On April 1, 1897, he was appointed General Freight Agent of the same road, a position which he held up to his death.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies, see advertising page 24.)

American Society of Mechanical Engineers.

The next monthly meeting of this society will be held in the Engineering Societies building, New York, April 14. The general subject at this meeting is to be "The Conservation of Our Natural Resources," which is now receiving unusual attention. The President of the United States has sent invitations to the Governors of the several states, and to the presidents of the national engineering societies, to confer in Washington on this important problem. The New York meeting will be addressed by four speakers on "Forest Preservation in its Relation to Water Power, Economy in the Utilization of Fuels, and the Attitude of the Engineer in Regard to These." Dr. Henry S. Pritchett, President of the Carnegie Foundation for the advancement of teaching, will discuss the "Relation of the Engineer to the Body Politic."

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

National Lines of Mexico.—M. M. Reynolds, Comptroller, has resigned to go to another company.

New York Public Service Commission, Second District.—Charles H. Keep, Commissioner, has resigned to become President of the Knickerbocker Trust Company in New York City.

Operating Officers.

Chicago, Burlington & Quincy.—F. H. Ustick, Superintendent at Aurora, Ill., has been appointed General Superintendent, with headquarters at St. Louis, Mo., succeeding George T. Ross, resigned. A. W. Brown, Superintendent at Ottumwa, Iowa, succeeds Mr. Ustick. Mr. Brown is succeeded as Superintendent by A. W. Newton, general inspector of permanent way and structures.

Delaware, Lackawanna & Western.—Edwin M. Rine, who is now Superintendent of the Morris & Essex division which includes all the New York end of the road and the Hoboken terminals, was born on September 4, 1868, at Brilliant, Ohio. After a school education he entered railroad service at the age of 18 on the Cleveland & Pittsburgh division of the Pennsylvania Lines West, as an operator. He was soon made a despatcher on the Pittsburgh & Western, now part of the Baltimore & Ohio. In 1889 he went to the South Carolina Railroad, now part of the Southern. After a year in the South he returned to Ohio as chief despatcher and later Trainmaster of the Baltimore & Ohio at Cleveland and at Akron. In 1899, the year in which Mr. Truesdale was elected President of the Lackawanna, Mr. Rine came to the road as chief despatcher, later becoming Trainmaster, and Superintendent of the Scranton division. On March 1, of this year, he was transferred from the central part of the road to the eastern end.

Missouri Pacific.—William E. Brooks, who is now Superintendent of the Joplin division of the Missouri Pacific, with headquarters at Nevada, Mo., was born on October 9, 1866, at Abingdon, Va. He had no school education and at the age of 14 went to work in a construction gang on the Lexington division of the Chesapeake & Ohio. The next year, when he was 15, he was an operator on that road and the year following went to the Santa Fe as operator. In April, 1884, when he was less than 18 years old he was made despatcher on that road, a position which he held for four years. In 1888 he went to the Kentucky Central, now part of the Louisville & Nashville, as despatcher, and in 1899, also as despatcher, to the Missouri Pacific. Three years after going to this road he was made chief despatcher, a position which he held for 13 years. In March, 1905, he was made chief clerk to the Assistant General Manager, and in April, 1906, Inspector of Passenger Service. From June to September, 1907, he was Superintendent of the Northern Kansas division; from September, 1907, to March, 1908, Superintendent of the Omaha division, and is now, under the recent reorganization of the operating department, Superintendent of the Joplin division of the Missouri Pacific.

W. S. Crane has been appointed Car Accountant, succeeding A. R. Duncan, resigned.

New York Central & Hudson River.—The headquarters of P. E. Crowley, Assistant General Manager, are to be moved from New York to Albany.

Peoria & Pekin Union.—George W. Walliser has been appointed Superintendent, with headquarters at Peoria, Ill., succeeding H. G. Kruse, resigned to go to another company.

Traffic Officers.

Delaware, Lackawanna & Western.—A. S. Learoyd, Division Freight Agent at Newark, N. J., has been appointed Assistant General Freight Agent, with office at New York, effective April 1.

Lake Erie & Western.—See New York Central Lines.

New York Central Lines.—William F. Carter, District Passenger Agent of the Lake Erie & Western, at Lima, Ohio, has been appointed General Agent of the New York Central Lines at Toledo.

Union Pacific.—H. O. Wilson, General Agent of the freight department at San Francisco, Cal., has been appointed General Agent of the freight and passenger departments at Los Angeles. Mr. Wilson is succeeded by S. F. Booth, who will also be General Agent of the passenger department at San Francisco, Cal.

Engineering and Rolling Stock Officers.

Chicago, Rock Island & Pacific.—William A. Nettleton, the new General Superintendent of Motive Power of this company, was born in 1863, at Hannibal, Mo. He graduated from the Sheffield Scientific School of Yale University in the class of 1885, and began railroad service in November of that year on the Kansas City, Fort Scott & Memphis. In 1888 he was a bridge inspector for Morison & Corthell and in the next year was with A. P. Boller as inspector of the bridge of the New York, New Haven & Hartford over the Thames river at New London, Conn. In that same year he returned to the Kansas City, Fort Scott & Memphis as Engineer of Tests, and held this position until 1892, when he served for a year as Superintendent of Terminals.

William A. Nettleton.

In 1893 he was appointed Assistant Superintendent of Motive Power of this road, and two years later Superintendent of Motive Power, a position which he held for six years or until 1902. In 1902 he went to the Atchison, Topeka & Santa Fe as Assistant Superintendent of Motive Power. In 1903 he was engaged in special work, and in 1904 he went to the railroad which had taken over the road on which his early service was spent, the St. Louis & San Francisco, of which as well as the Chicago & Eastern Illinois he became General Superintendent of Motive Power. After four years service in this position he went to the Chicago, Rock Island & Pacific on March 1, 1908, as General Superintendent of Motive Power, with headquarters at Chicago.

New York Central & Hudson River.—The headquarters of John Howard, Superintendent of Motive Power, and of F. W. Brazier, Superintendent of Rolling Stock, are to be moved from New York to Albany.

Union Pacific.—George J. Hatz has been appointed Superintendent of Shops at Omaha, Neb., succeeding H. Stovel, deceased.

Special Officers.

Mexican Central.—B. C. Fleming has been appointed Advertising Manager.

LOCOMOTIVE BUILDING.

Butler Bros., Hibbing, Minn., have ordered 30 six-coupled switching locomotives from the Baldwin Locomotive Works.

The New York Central & Hudson River has ordered 136 locomotives of various types from the American Locomotive Co. The numbers of each type have not yet been decided, but included in the total will be 12 electric engines.

The Chicago, Milwaukee & St. Paul is building 30 simple six-wheel switching (0-6-0) locomotives at its Milwaukee shops. The specifications are as follows:

General Dimensions.

Type of locomotive	Switching
Weight, total	127,000 lbs.
Diameter of drivers	50 in.
Cylinders	19 in. x 26 in.
Boiler, type	Straight top
" working steam pressure	180 lbs.
" number of tubes	238
" diameter of tubes	2 in.
" length of tubes	12 ft. 5⅛ "
Firebox, length	7 " 7⅛ "
" width	3 " 6 "
" grate area	25.8 sq. ft.
Heating surface, total	1,708 "
Tank capacity	4,500 gals.
Coal capacity	4½ tons

Special Equipment.

Brake-shoes	Chicago, Milwaukee & St. Paul
Headlights	Adams & Westlake
Journal bearings	Hewitt
Piston rod packing	Edwards
Valve rod packing	Edwards
Safety valve	Richardson
Sanding devices	Leach

CAR BUILDING.

The Chicago Railways Co., as reported in the *Railroad Gazette* of January 10, has ordered 300 double-truck electric cars from the Pullman Co. and 50 cars from the Pressed Steel Car Co.

The Chicago, Milwaukee & St. Paul, as reported in the *Railroad Gazette* of March 13, is building 2,500 stock cars of 60,000 lbs. capacity at its Milwaukee shops. These cars will be 36 ft. 1¼ in. long, 8 ft. 6¾ in. wide and 7 ft. 5¼ in. high, inside measurements. They will have Bettendorf underframes. The special equipment includes:

Bolsters	Bettendorf
Brake-shoes	Congdon
Brasses	Hewitt
Door hangers	Climax
Trucks	Bettendorf

Three hundred cars of this lot will be double-deck, and the rest (2,200) will have water trough arrangement.

The Cold Blast Transportation Co. (Schwarzschild & Sulzberger), Chicago, has ordered 300 stock cars of 60,000 lbs. capacity from Haskell & Barker, instead of 200 refrigerator cars as reported in the *Railroad Gazette* of March 20. These cars are for May and June delivery, and will measure 36 ft. long and 9 ft. wide, inside measurements; they are to be built of wood with wooden center sills. The special equipment includes:

Bolsters	Haskell & Barker
Brake-beams	Haskell & Barker
Brake-shoes	Haskell & Barker
Brakes	Westinghouse
Couplers	Latrobe
Draft rigging	Williams & Priest
Wheels	Haskell & Barker

The Chicago, Milwaukee & St. Paul, as reported in the *Railroad Gazette* of March 20, has ordered 15 passenger coaches from Barney & Smith and three dining cars from the Pullman Co. The coaches will be 60 ft. long, 9 ft. wide and 9 ft. 10 in. high, inside measurements. The dining cars will be 70 ft. long, 10 ft. wide, over frame, and 15 ft. 6 in. high, over all. The special equipment for both will include:

Bolsters (for dining cars)	American Steel Foundries
Brake-beams	"Diamond" special
Brake-shoes	Congdon
Brasses	Hewitt
Curtain fixtures (for coaches)	Forsyth
Curtain fixtures (for dining cars)	Schroyer
Curtain material	Pantasote
Draft rigging (for coaches)	Westinghouse
Draft rigging (for dining cars)	Miner
Paint	Chic., Mil. & St. Paul standard
Vestibules	Pullman
Wheels (for dining cars)	Paige

The Atlantic Coast Line, as reported in the *Railroad Gazette* of March 20, has ordered, for the Washington & Vandemere, 100 felt insulated ventilated box cars of 60,000 lbs. capacity from the South Baltimore Steel Car & Foundry Co., for April 15 delivery. The inside measurements will be 36 ft. long, 8 ft. 6 in. wide and 7 ft. 6 in. high. The over-all measurements will be 39 ft. long, 11 in. wide and 13 ft. 8⅞ in. high. Bodies and underframes will be of wood. The special equipment includes:

Axles	Steel
Bolsters, body	Cast-steel
Bolsters, truck	Open-hearth, I-beam
Brakes	Westinghouse
Brake beams	Pennsylvania
Brake-shoes	Cast iron
Couplers	Tower
Door fastenings	National Malleable Castings Co.
Draft gear	Farlow Twin Spring
Dust guards	Harrison
Roofs	Murphy outside
Springs	Railway Steel Spring
Trucks	Company's standard, arch bar
Ventilators	Company's standard, on ends
Wheels	Maryland Car Wheel Co.

RAILROAD STRUCTURES.

BATTLE CREEK, MICH.—The Grand Trunk, it is said, will put up repair shops here.

BRANDON, MAN.—The Canadian Northern, it is said, will soon begin work on a large station here.

GRAND FORKS, B. C.—The improvements to be carried out here by the Canadian Pacific include a 15-stall roundhouse to cost $70,000, passenger station and office building, $49,000, and yard improvements $40,000.

HOMER, LA.—The Louisiana & Northwest is said to be planning to put up shops and other improvements here to cost about $100,000.

NANAIMO, B. C.—Work on the Esquimalt & Nanaimo includes putting up a steel bridge at Raymond's crossing, two between Duncans and Shawnigan Lake, also one at Chemainus over the Nanaimo river. The present wooden bridge over Cowichan river is also to be replaced with a steel structure.

SAN ANGELO, TEX.—The Kansas City, Mexico & Orient, reports say, will build roundhouses here in addition to the proposed combined passenger station and freight house.

TRENTON, N. J.—Commercial interests of Philadelphia and Trenton, N. J., are opposed to the plans of the Pennsylvania for a bridge over the Delaware river from West Morrisville, Pa., near Trenton, to connect with the freight relief line to be built under the name of the Pennsylvania & Newark, east to Newark, N. J., about 50 miles. The proposed structure is to have 11 spans, each 100 ft. wide, with two draws of the same width over the channel, and a height in the clear of 34 ft., with draws closed. Objection is made that the bridge will interfere with river navigation.

UTICA, N. Y.—The Public Service Commission, Second district, has approved the plans of eliminating the Genesee street grade crossings, in Utica, by putting up a steel viaduct 68 ft. wide over the New York Central tracks at a cost of about $370,000.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ABERDEEN & TOMBIGBEE VALLEY.—The subscriptions to the underwriting agreement to secure the bonds for building this line in Mississippi has been nearly three times over subscribed. As reported in our Construction Record the line is now being built from Okolona, Miss., southeast to Pickensville, Ala., all surveyed, and grading finished between Okolona and Aberdeen on 17.5 miles, also Columbus to Pickensville, 11.5 miles. W. T. McKee, Chief Engineer, Aberdeen, Miss.

BIENVILLE-QUITMAN.—Incorporated in Louisiana, with $100,000 capital, to build a line from Bienville, La., east to Quitman, 12 miles. D. C. Richardson, President, Bienville. The D. C. Richardson-Taylor Lumber Co., it is said, is back of the project.

BRINSON RAILWAY.—This company, incorporated to build from Savannah, Ga., northwest to Athens, 180 miles, last year finished the first 25 miles from Savannah to Springfield. The company has bought terminal property at Savannah, and will shortly issue bonds to extend the line to Sylvania, 32 miles. G. M. Brinson, President and Superintendent, Springfield, Ga. (March 13, p. 390.)

CAIRO & NORFOLK.—Incorporated in Kentucky, with $500,000 capital, to build a line from Port Jefferson and Bullard county, along the Mississippi river to Bristol, Va. Incorporators include L. W. Goode and E. E. Weston, of New York; F. R. Allen and C. B. Goode, of Mayfield; W. A. Usher, H. C. Neal and E. S. Beaumont.

CANADIAN PACIFIC.—Announcement is made that this company will open its Toronto-Sudbury line for traffic June 15. (March 13, p. 396.)

CANADIAN VALLEY RAILROAD.—Incorporated by residents of Mutual, Okla., with a capital of $2,000,000. Proposes to build from Fort Supply, Woodward county, Okla., southeast through the counties of Woodward, Dewey, Blaine, Canadian and Oklahoma to Oklahoma City, 150 miles. The estimated cost of the line will be $25,000 a mile.

CHEROKEE BELT & INTERURBAN.—Incorporated in Oklahoma with $500,000 capital and office at Tulsa, Okla., and at Kansas City, Mo., the company proposes to build a line from the Midland Valley Railroad to the Missouri, Kansas & Texas, through the counties of Craig, Tulsa, Rogers & Myers. Incorporators include F. O. Montel, of Kansas City; C. W. Butterworth, of Tulsa; and E. Pease, J. R. Caudley and A. E. Leahe, of Collinsville, Okla.

CHICAGO, LAKE SHORE & SOUTH BEND (ELECTRIC).—Work on this line, building from South Bend, Ind., west to Chicago, Ill., 71 miles, has all been finished except 13 miles between South Bend and Michigan City. Announcement is made that this section is to be opened June 13, and the entire line is to be in operation about July 1st. (March 13, p. 390.)

CHICAGO, MILWAUKEE & ST. PAUL.—The Pacific coast line has been extended from Terry, Mont., west to Lombard, about 337 miles, and this section was put in operation March 15. There remains about 118 miles to finish the line to Butte. Track laying, it is said, will be started at once both east and west from Lind, Wash., where the line crosses the Northern Pacific, and shortly thereafter at Plummer, Idaho.

CHICAGO, ROCK ISLAND & PACIFIC.—An officer writes regarding the report that this company has work under way on the entire line from Amarillo, Tex., west to Tucumcari, N. Mex., 110 miles, that track laying was started this month on the first 20 miles, which is all the work planned to be carried out on this line at this time. (Mar. 13, p. 390.)

COAL & COKE.—Rights of way are reported secured and work is to be started at once by this company, on an extension from Gassoway, W. Va., southeast via Sutton to Webster Springs, 40 miles. The plans include a tunnel three-quarters of a mile long through Elk mountain.

CROW'S NEST & NORTHERN.—A bill has been passed by the Canadian Parliament authorizing this company, recently incorporated in Canada with a capital of $2,000,000, to build a line from a point on the Canadian Pacific, just west of Crow's Nest, B. C., north to the summit or divide between the waters of the North Fork of Michel creek and the waters of Grave creek, via the west side of the North Fork of Michel creek to the confluence of the two north branches, thence by both branches to points near the divide. The bill also authorizes the company to build branch lines not more than 10 miles long. Construction work is to be started as soon as the weather permits, and it is the intention of the company to have the line finished before next winter. All the rights of way have been secured and surveys made. Contracts for grading, track laying, bridges, etc., are soon to be let. The line is to be built to market the output of the Crown Coal & Coke Company, and of the Michel Coal Mines, Ltd. The office of the company is to be at Crow's Nest, B. C. R. J. Belden, of the Crown Coal & Coke Company, Spokane, Wash., may be addressed. (March 6, p. 328.)

GRAND TRUNK PACIFIC.—This company has reached an agreement with the British Columbia Government, and plans are now under way to let contracts for additional sections east from Prince Rupert, B. C. A total of 300 miles will soon be under contract on the line between the Pacific and the Rockies. Active work is under way laying out the terminal city at Prince Rupert. Contract for the first 100 miles let to Foley, Walsh & Stewart, it is stated will cost about $10,000,000. This section extends from Prince Rupert to a point on the Skeena river, skirting the Pacific ocean for some 25 or 30 miles. Nearly all the excavation will be through rock and the work must be finished by September, 1909. About 2,000 men will be put to work as soon as they can be secured.

J. D. MacArthur, who has the contract for building 244 miles of line from a point east of Winnipeg east to the junction with the Lake Superior branch, has had 7,000 men at work on this section all through the winter. About 60 per cent. of the construction work is finished. The contract calls for a number of steel and concrete bridges.

LIMA & TOLEDO TRACTION.—See Ohio Electric Railway.

LOS ANGELES & SAN FRANCISCO SHORE LINE.—Incorporated in California, with $441,000 capital, to build a line from Los Angeles north to San Francisco. Surveys are said to have been made which give a line about 80 miles shorter than the Southern Pacific. John Cross, President and General Manager, Los Angeles.

LOS ANGELES HARBOR COMPANY.—See Los Angeles Harbor Railroad Co.

LOS ANGELES HARBOR RAILROAD COMPANY.—A company was recently incorporated in California under this name, also one under the name of the Los Angeles Harbor Company, each having a capital of $2,500,000. Rights of way have been secured for a proposed line from Wilmington, Cal., at Tidewater, to Los Angeles, about 25 miles. A. C. Bird, of Compton, formerly Vice-President of the Gould Lines in charge of traffic, is President of both companies.

MEXICAN ROADS.—The British syndicate which owns extensive coal fields at Furbero, Vera Cruz, is said to have given a contract to build a line from Furbero to Tuxpan, 80 miles. H. S. Armstrong, formerly at Monterey as Resident Engineer of the Mexican Central, is Chief Engineer. J. S. Nickerson, of Mexico, is also interested in the project.

Bids are to be asked for in June by P. O. Pruto, P. O. Box 138, Parral, Chihuahua, to build a line from Parral east to Jimenez, 60 miles.

OHIO ELECTRIC RAILWAY.—Work has been resumed on the Lima & Toledo, building from Deshler, Ohio, north to Toledo, 30 miles. The section from Toledo south to Waterville is almost finished and about 20 miles from Deshler north to Waterville is yet to be built. (March 13, p. 393.)

PECOS & BALMORHEA.—Application is being made by a company under this name for incorporation by residents of Toyah Creek valley to build a line from Pecos, Tex., south to Balmorhea, 50 miles.

Over $50,000 and the necessary lands for terminal facilities have been subscribed.

Ruston, Natchitoches & Northeastern.—Incorporated in Louisiana to build a line from Ruston north to Farmerville, about 25 miles. J. C. Nolan, President; E. L. Kidd, Secretary and Treasurer, Ruston.

San Francisco & Bay Counties Railway (Electric).—See San Francisco, Oakland & San Jose Consolidated.

San Francisco, Oakland & San Jose Consolidated (Electric).—Under this name it is reported a company has been formed with a capital of $7,750,000 as a consolidation of the San Francisco, Oakland & San Jose, operating 25 miles of electric line connecting by ferry with San Francisco, Cal., and the San Francisco & Bay Counties Railway. The latter was recently incorporated to build an electric line from San Francisco south to San Jose. E. A. Heron, D. Searls and F. M. Smith are directors.

San Francisco, Oakland & San Jose (Electric).—See San Francisco, Oakland & San Jose Consolidated.

Spokane, Portland & Seattle.—The section which was built last year from Kennewick, Wash., opposite Pasco, west to Vancouver, 220 miles, is expected to be opened by June. The extension to Spokane, 145 miles, is also to be put in operation this year. (March 13, p. 395.)

Western & Atlantic.—Residents of Camden county, Ga., agree to furnish the right of way and terminal site at St. Mary for an extension of this road from Atlanta to the deep water harbor at St. Mary. Several counties along the proposed route, it is said, are now taking action to grant the necessary right of way.

RAILROAD CORPORATION NEWS.

Bainbridge Northeastern.—Col. M. Wilkinson, of Valdosta, Ga., was on March 2 appointed receiver of this company by Judge Speer in the United States District Court at Savannah. The Bainbridge Northeastern is 18 miles long and runs from Bainbridge to within two miles of Swindell, both in Decatur county, Ga.

Brinson Railway.—The stockholders of this company, which was incorporated in Georgia in May, 1906, and has built 25 miles of road from Savannah, Ga., to beyond Springfield, are to meet on April 6 to authorize a bond issue at the rate of not more than $10,000 a mile for the first 100 miles and $15,000 a mile for the rest of the line. The road, as projected, is 180 miles long. See Railroad Construction column.

Brooklyn Rapid Transit.—It is reported that the firm of J. P. Morgan & Co. has become interested in the financial management of this company, which controls the elevated lines and most of the surface lines in Brooklyn, N. Y.

Chicago, Indiana & Southern.—It is reported that the sale of $15,000,000 fifty-year 4 per cent. bonds of this company, guaranteed by the Lake Shore & Michigan Southern, is being negotiated with J. P. Morgan & Co.

Cincinnati, Hamilton & Dayton.—Holders of the $11,558,000 4 per cent. refunding bonds may exchange these bonds at par up to July 15, for the new collateral purchase money notes. (January 10, 1908; p. 74.)

Erie.—There are $5,500,000 discount notes, issued in April, 1907, which fall due April 8, 1908.

Grand Trunk Pacific.—This company recently offered $10,000,000 (£2,000,000) 4 per cent. securities in London, of which the underwriters are reported to have had to take between 50 and 90 per cent.

Indiana, Columbus & Eastern Traction.—See Ohio Electric Railway.

International & Great Northern.—Gross earnings for the week ended March 21, 1908, were 18 per cent. less than for the corresponding week in 1907.

Kansas City Southern.—Gross earnings for February decreased 9 per cent.; operating expenses increased 7 per cent., and net earnings after taxes decreased 38 per cent.

Lehigh & New England.—See Lehigh Coal & Navigation Company.

Lehigh Coal & Navigation.—The stockholders of this company have the opportunity to subscribe to the $1,734,500 new stock at par to the amount of 10 per cent. of their holdings. The proceeds will be used for general improvements, which may include betterments on the Lehigh & New England Railroad, which is owned by the Lehigh Coal & Navigation Co.

Mexican Southern.—The narrow (3 ft.) gage line of this company runs from Puebla, Puebla, Mexico, to Oaxaca, Oaxaca, 367 miles, with a 50-mile tramway branch from Tehuacan north to Esperanza. The stockholders have recently been offered $500,000 (£100,000) 4 per cent. "first mortgage debenture" stock at 82. The proceeds are to be used chiefly to convert the tramway into a steam railroad with 3 ft. gage.

New Orleans Terminal.—Potter, Choate & Prentice, of New York, have offered at 98¼, to yield 7¾ per cent., a block of the $2,500,000 two-year 6 per cent. notes due April 10, 1909. These notes are guaranteed by the Southern and by the St. Louis & San Francisco and are secured by $4,000,000 first mortgage 4 per cent. bonds of the New Orleans Terminal Company, which bonds are also guaranteed by these two railroads. Besides its several terminal properties, the company owns 18 miles of belt railroad.

New York Central Lines.—The gross earnings, expenses and net earnings of the various New York Central Lines for the month of January, 1908, with the increase or decrease as compared with January, 1907, are shown below. These figures, for purposes of comparison, are compiled on the same bases as in the previous year and differ from those reported to the Interstate Commerce Commission under the present accounting rules.

	1908.	Change	
New York Central & Hudson River.			
Gross earnings	$6,636,494	Dec.	$776,000
Expenses	5,571,069	"	608,221
Net earnings	$1,065,425	Dec.	$167,779
Lake Shore & Michigan Southern.			
Gross earnings	$2,932,442	Dec.	$532,175
Expenses	2,211,044	"	356,158
Net earnings	$721,398	Dec.	$176,017
Lake Erie & Western.			
Gross earnings	$349,232	Dec.	$64,270
Expenses	300,609	"	9,564
Net earnings	$48,623	Dec.	$54,706
Chicago Indiana & Southern.			
Gross earnings	$248,640	Inc.	$3,214
Expenses	162,827	"	5,973
Net earnings	$85,813	Dec.	$2,761
New York, Chicago & St. Louis.			
Gross earnings	$775,238	Dec.	$41,059
Expenses	665,120	"	12,215
Net earnings	$110,118	Dec.	$28,844
Michigan Central.			
Gross earnings	$1,956,139	Dec.	$322,688
Expenses	1,654,542	"	218,960
Net earnings	$301,597	Dec.	$103,728
Cleveland, Cincinnati, Chicago & St. Louis.			
Gross earnings	$1,821,799	Dec.	$7,002
Expenses	1,524,448	"	66,197
Net earnings	$297,351	Inc.	$59,195
Peoria & Eastern.			
Gross earnings	$251,247	Inc.	$9,481
Expenses	176,660	Dec.	20,946
Net earnings	$74,587	Inc.	$30,427
Cincinnati Northern.			
Gross earnings	$56,854	Dec.	$17,334
Expenses	53,404	"	1,632
Net earnings	$3,450	Dec.	$15,702
Pittsburgh & Lake Erie.			
Gross earnings	$586,058	Dec.	$506,090
Expenses	460,210	"	383,291
Net earnings	$125,848	Dec.	$122,799
Rutland.			
Gross earnings	$185,885	Dec.	$9,010
Expenses	157,425	Inc.	11,504
Net earnings	$28,460	Dec.	$20,515

Ohio Electric Railway.—A block of the Indiana, Columbus & Eastern Traction Company's general and refunding mortgage 5 per cent. bonds, due 1926 are being offered at 96. The mileage owned or leased is 445 miles of electric line in Ohio. The Indiana, Columbus & Eastern is itself leased by the Ohio Electric Railway which guarantees interest on these bonds. With connecting lines in Ohio and Indiana controlled by the same interest, the Indiana, Columbus & Eastern forms part of a system of 1,700 miles of electric line.

Pere Marquette.—The First National Bank of Chicago is offering at par $900,000 6 per cent. equipment notes dated March 1, 1908, maturing up to and including 1911. These notes are part of the new issue which has been exchanged for the 5 per cent. equipment notes of the Eastern Equipment Company, which matured March 1, 1908. (March 6, 1908, p. 330.)

Pittsburgh, Cincinnati, Chicago & St. Louis.—Operating expenses and taxes in February decreased more than gross earnings, so that there was an increase of $13,500 in net earnings.

Texas & Pacific.—Gross earnings for the week ended March 21, 1908, were 25 per cent. less than for the corresponding week in 1907.

United Railways Investment Company.—This company is to issue at least $3,000,000 6 per cent. serial notes maturing yearly up to 1917, as authorized in June, 1907, by the stockholders. The proceeds are to be used to pay the floating debt of the United Railroads of San Francisco.